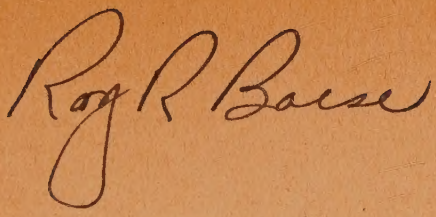
ASTRONOMY *and the* BIBLE



Astronomy and the Bible

LICK OBSERVATORY, MOUNT HAMILTON, CALIFORNIA

ASTRONOMY *and the* BIBLE

THE EMPIRE OF CREATION SEEN IN THE DUAL LIGHT OF SCIENCE AND THE WORD

BY

LUCAS A. REED, M. S.

"Teach me your mood, O patient stars,
Who climb each night the ancient sky,
Leaving on space no shade, no scars,
No trace of age, no fear to die."

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Preface

THE writer of the following pages, throughout his active life, has been a close student of nature, and the starry universe all about us has had its full share of his attention. He has gathered a fine assemblage of most entertaining facts; and the reader, whether a believer in the Bible or not, will be interested in observing that the astronomy of the Bible is far in advance of the time in which it was written, for only after some of the latest research with telescope, spectroscope, and camera, have seemingly obscure and meaningless passages of the Bible been understood.

Dr. Reed has been a popular writer for magazines, as well as of books; and one of his major themes has been the astronomy of the Bible. The popularity of his astronomy magazine articles, and the urgent demand that many of them be printed over and over again, has led to the preparation of this book.

Vibrant in the pages that follow is the sentiment of the inspired poet that "the heavens declare the glory of God; and the firmament showeth His handiwork. Day unto day uttereth speech, and night unto night showeth knowledge. There is no speech nor language; their voice is not heard. Their line is gone out through all the earth, and their words to the end of the world. In them hath He set a tabernacle for the sun." Ps. 19: 1-4.

The invisible God, whose glory is too bright for sinful, weakened mortal eye, may be clearly seen through

the things He has made; for the apostle is bold to declare that "that which is known of God is manifest in them; for God manifested it unto them. For the invisible things of Him since the creation of the world are clearly seen, being perceived through the things that are made, even His everlasting power and divinity." Rom. 1: 19, 20.

The universe is not a mere jumble of suns and worlds, a freak of chance operating blindly through the undirected laws of nature; neither are some of the suns and worlds about us "young" and growing toward the strength of manhood life and power, while others are "old" and waxing to decay; but the omnipotent hand of God is behind all of His works, and His infinite intelligence is directing every star and world and all of the forces of nature in earth and sea and sky.

The marshaling of the facts and of the scriptures which show that God is intelligently, actively, and lovingly at work through all of the operations of nature, will be found a constant delight, inspiration, and satisfaction to the reader. God so loves us that He seeks to touch us through many avenues. If He is not able to appeal to us through His written Word, He then appeals through the forces of nature. He speaks to us by means of sun and moon and all the retinue of celestial orbs, so that He may lead us to touch and to know His invisible presence through His visible creation.

One cannot fail to be impressed with the truth and the dependableness of the infinite Creator as he beholds His handiwork in the numberless stars and the orderly movement of all the stellar worlds. The joys and the

soul rest that come through actually knowing God and being in touch with Him by a living experience are beyond our powers to describe, but nevertheless we may know them and find perfect rest under the ever pervading shadow of the Almighty.

That those who do know God may have their appreciation of Him intensified, and that those who do not know Him may be introduced to Him through the pages that follow, is the earnest wish of

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Introduction

For eight years, Kepler sought unceasingly, with unremitting toil, to solve the law of planetary motion. During those years, he tried nineteen different hypotheses. One after another of these he was compelled to lay aside as not conforming to the motion of the planets. His courage and patience transfigured failure into success. When, after days of study and nights of observation, the months showed a theory untenable, he turned from it without regret, knowing that there was one less theory to try. At last, he was compelled to give up every theory of the circle as the explanation of orbital motion. He then chose the next to the circle in simplicity, the ellipse. Here he found all the conditions met. The problem at last was solved, and he cried, "O almighty God, I am thinking Thy thoughts after Thee!" When he had established his second and third laws, and written his exposition of them, he said: "My book is written to be read either now or by posterity; I care not which. It may well wait a century for a reader, since God has waited six thousand years for an observer."

Thus in a realization that the scientist is but tracing the handwriting of the Creator, and with an abiding faith that His writing is intelligible, and contains a divine message, did such men as Kepler and Newton lay the foundations of our present knowledge.

Some of the men accounted great to-day — mere pygmies compared with the men just mentioned —

have the effrontery to tell us that they see in the heavens no trace of a God. But in making such a statement, they but confess their own blindness and dumbness. They are like one who cannot read, pointing at the letters of the printed page, and saying there is no trace of knowledge or intelligence there.

To disbelieve in God, a man must believe in a thousand anomalies which he cannot reconcile with reason; and he must accept contradictions and improbabilities without number. He must assume that effects are greater than their causes; that the greatest effects are without any cause at all; in fact, that something, and a mighty something at that, came from nothing.

That he may not see evidences of God, the atheist must close his eyes to the light which shines upon him everywhere, from sun and stars, and reflected from satellite and planet, and that also gleams from the eyes of countless intelligent creatures in the world about him.

That he may not hear the message of God in nature, he must close his ears to the voices that sound in creation's harmonies, from the hum of insects and the songs of the birds, up to that silent thunder of uncounted worlds and suns and systems which pour into the ear of the soul the mighty music of the spheres.

The irreligious scientist is a contradiction. The undevout astronomer has become spiritually deranged. A study of nature will soften and subdue man's heart, if he does not stubbornly harden it. Astronomy will give to the man who rightly studies the wonders of the heavens a modesty and humility regarding his own at-

tainments, and an admiration and devotion for the One whose works declare the grandeur and the glory of His holy and exalted personality; and he will turn with added confidence and joy to the Book that explains all. Thus will he know the blessing gained by a study of astronomy and the Bible.

LUCAS A. REED.

Creation

THE spacious firmament on high,
With all the blue, ethereal sky,
The spangled heavens, a shining frame,
Their great Original proclaim;
Th' unwearied sun, from day to day,
Does his Creator's power display,
And publishes to every land
The work of an almighty hand.

Soon as the evening shades prevail,
The moon takes up the wondrous tale,
And nightly, to the listening earth
Repeats the story of her birth;
While all the stars that round her burn,
And all the planets in their turn,
Confirm the tidings as they roll,
And spread the truth from pole to pole.

What though in solemn silence, all
Move round the dark terrestial ball?
What though no real voice or sound
Amid their radiant orbs be found?
In reason's ear they all rejoice,
And utter forth a glorious voice,
Forever singing, as they shine,
"The hand that made us is divine."

—*Joseph Addison.*

OMEGA CENTAURI

One of the many star clusters, each composed of immense glowing suns far larger than our own.

THE HEAD OF A COMET

This drawing gives one an idea of the size of a comet as compared with the earth. The brightest spot in the head of a comet is called the nucleus; surrounding this are layers of luminous matter, from which the tail streams away.

CHAPTER I

Astronomy and the Bible

OF all the sciences, astronomy makes the most nearly universal appeal. Persons who have little interest in even the common things about them, are nevertheless often deeply interested in knowing something of those heavenly lights which shine down upon them.

What are these stars? Are they other worlds at all like ours? How many of them are inhabited? What of their distance and of the scale on which the universe is built? What is that large red star, and this bright white one? What is the Milky Way? Why does the North Star always remain north?

These and countless more questions rise at once when the subject is introduced. All these questions are worthy of a careful answer. The science of astronomy deserves to be understood. And of its large and most important features, every student may gain some definite and useful knowledge.

To outline some of the principles of astronomy, never exceeding the limit of true science, and to weigh,

in relation to those principles, the words of the Bible,—these are our aims in this book. Such a view will not narrow our conceptions of astronomy. We shall see, before we are through with the study, that only thus can we comprehend the grandeur, the dignity, the sublimity, the uplifting urge, of this important science.

Thus viewing it, we are carried back to the ages when the universe began. We view the dawn of creation. We hear the first whisper of the creative word. We see the first appearings of the material world under the manifestations of divine energy.

Thus, too, we learn how the mighty universe is sustained. We contemplate its complicated mechanism of wheel within wheel rolling on in the deeps of space, as age follows age. We gaze with eager eyes into the ages to come. We behold order and system and ever advancing variety and magnitude. We ponder the might of immensity and the greatness of eternity. The finite mind expands, seeking evermore to grasp the measures of the infinite.

Were it not for the Bible, our conceptions would take in too little, even though we might be aided by all the means and methods of modern astronomy. In the Word, our vague guesses and groping questions are answered by the most daring of revelations, the grandest of delineations, the most sublime of statements.

Indeed, no one can rightly understand astronomy, aside from the Bible. This is paramountly true, whether we contemplate the beginnings of things, "when the morning stars sang together, and all the

sons of God shouted for joy," or run forward in thought to the coming age, when there shall rise a new heaven and a new earth, and the former things shall have passed away.

The Bible is the supreme textbook. Like a towering rock that fronts the sea, its granite wall is forever receiving the onslaught of the waves. One moment, the waters strike upon its fending sides, and break in forceless spray; the next, the sunbeams touch and transfigure the old water-washed rock with diamond gleams of light. Thus, with radiant and unbroken front, the Word stands immovable through the ages, our wall of protection from error and folly. That mighty wall of truth remains impregnable to-day as ever.

There is no controversy between true science and the Bible. Both are manifestations of divine truth. True science but makes more brilliant the gems of Holy Writ; and the Bible ever guides the mind more deeply and sublimely into the wonders of true science. Each is the handmaid of the other. In the Bible, we find the great principles of truth; in nature, we find facts that explain, illustrate, and make clear the truth of the Word.

Truth is a unit. It is not separate, antagonistic things. Though manifold — indeed, infinite — in the variety of its manifestation, it is one harmonious system. And this one truth, revealed in the Bible, "is reflected as from a mirror, in the face of nature."

This complete revelation of truth, inspiration calls "the Word." And the term "word," or "logos," im-

plies that a mind has expressed itself, not merely in words, but in "the Word"; that is to say, a symmetrical whole. But the mind that has thus expressed itself is the divine mind; and its expression is a manifestation of realities.

It is "the Word," for it speaks. It produces realities; for that Word is creative, pouring forth divine energy. It spoke at creation; and what it commanded, obeyed by existing. That Word said, "Let light be;" and light was. The Bible may give us in words "the Word" of God; but that Word is also manifested in the world it created and still sustains. If in nature there is anything not produced and sustained by "the Word," it is but some temporary thing, the result of some other mind, a mind antagonistic to the divine mind. And this transient element, discerned by its vanity and falsity, will eventually pass away. But "the Word" of God, and He who is in that Word, and makes it vital, efficient, and substantial, will abide forever.

As words express the thoughts, or mind, of a man, so "the Word" expresses, reveals, discloses the divine mind. The Bible is the echo of the divine mind, and so it is called "the Word of God." When it is ministered to us by the Spirit, it becomes at once the living, acting Word of God; and such it is truly called. Christ is the revelation, the "outgoing," of God's mind, or character; and therefore He is called "the Logos," or "Word." John 1:1-3. And nature, too, though clouded by sin, is a panorama of God's thoughts to His creatures, and hence is called "the other word."

In Christ, the personified Word, "are hid all the treasures of wisdom and knowledge." Col. 2:3. Think of the all-comprehending meaning of the marvelous expression, "all the treasures of wisdom and knowledge." These treasures include all the unsearchable and unfathomable deeps of the divine mind. Inspiration, catching in one glimpse the infinitude of these treasures, cries out, "O the depth of the riches both of the wisdom and knowledge of God!" Rom. 11:33.

O the depth indeed!

And all this knowledge and wisdom, all indeed that there is, has been revealed to us in Jesus Christ. He Himself says, "All things that the Father hath are Mine." John 16:15. These "all things," the Spirit receives to show to the disciples of Christ.

And what a comprehending sweep of things is included in that expression, "all things that the Father hath"! How much has He? Look yonder into the heavens. Behold a thousand suns rolling in the abyss of space; and around them, held by them, attendant worlds teeming with life and beauty — stars upon stars, and worlds upon worlds, universe beyond universe, creation beyond creation. All that we see is but a tiny suburb of the great creation.

We take a five-inch glass and look at one mere spot in the heavens. Wonder of wonders! It is transformed into hundreds of suns, so closely studded together that we cannot number them.

We find a stronger glass. Still other suns appear, suns upon suns, as the sands of the seashore, innumer-

able. It is impossible to pierce to the outer bounds of the gleaming stars; for still we see lights gleaming from beyond, where all grows cloudy and obscure.

All are Christ's. The fullness of God is there, the complete revelation, all the treasures of wisdom and knowledge, all the deeps of infinite thought and action.

Then the Bible must be our aid in the study of all science, astronomy included; for the Bible is our only means of intelligently receiving and knowing Christ. And these treasures "in Him" include all the treasures of truth, all forms of true science. The word "all" bars any exceptions.

This is not to say that the Bible contains every possible phrasing of truth, or every single detail of it. We are told that if all that Jesus did were written, it is supposed that even the world could not contain the books that should be written. Yet His life, the unity, the completeness of His life, is contained in the Bible. That the world could not contain all the books that might be written of His life, is because the principles represented are manifestations of infinite truth; and infinite truth, to be fully expressed, requires infinite expression. But thus infinitely expressed, all truth would fill the world, and, indeed, the universe itself; and would fill it not only now, but throughout eternity.

Yet in the Bible, in principles of infinite meaning, in words of never ending import, is recorded the all-wisdom of God. All that is of God is in the Word. It is locked in comprehensive statements that cannot fail to be understood, yet so richly stored that they become treasures as inexhaustible as eternity and God.

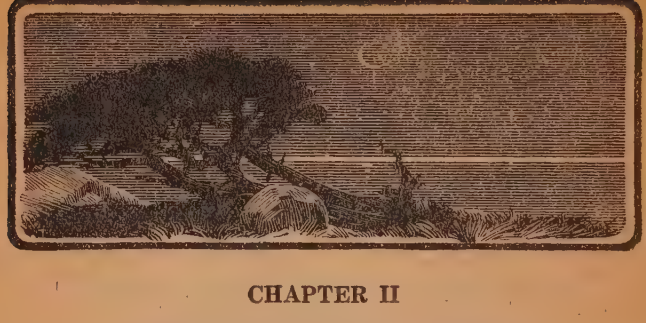
To survey them adequately, demands capacity most mighty and lives immortal, with means of reaching and observing unhampered His ever expanding domains.

But remember that even now we have in the Bible all the great principles included in these things. In the Bible, they have been committed to man. True, they are locked in the storehouse; but God has given us the key. They are hidden; but He has told us to seek, and we shall find. Though the door is closed, it will be opened to us if we knock.

For this, the study of astronomy and the study of the Bible are combined. We mention astronomy first, not because it is first in importance, but because we give it here the most attention. This book is not primarily a study of the Bible, but a study of astronomy. Yet throughout, we seek the aid of the sublime words of Sacred Writ. And we find a better understanding of the Bible through the light that science gives.

May all our science study be after this manner! Let us search both nature and the Word as for hidden treasure. God Himself will be the Teacher; His Word will be our textbook; His works, our field of observation; His everlasting habitations, our schoolroom; and eternity, the term of our pupilage.

Thus our lives will grow richer and happier, our minds more vigorous and comprehending, while our vision "forever widens with the process of the suns."



CHAPTER II

Astronomy and Faith

"LIFT up your eyes on high, and behold who hath created these things, that bringeth out their host by number: He calleth them all by names by the greatness of His might, for that He is strong in power; not one faileth." Isa. 40:26.

This is God's invitation to the study of astronomy. Every one should study this science. It is the most delightful and the most inspiring of all the sciences. It elevates and broadens the mind. It rouses and directs the imagination. It gives man a truer idea both of himself and of his Creator. And in a better understanding of God, science finds its true service.

When we find that the stars are unmeasured distances from us, and that they are innumerable, spangling the heavens with jets of radiance infinite in number, we are in better condition of mind to realize the glory of Him who brings "out their host by number," calling "them all by names."

And viewing their eternal constancy, as they move undeviatingly in their orbits, we shall perceive back of

them the power of God that forever keeps them as they are, "by the greatness of His might, for that He is strong in power; not one faileth."

Rarely nowadays is astronomy studied with any such purpose as is here indicated. Yet, if not so studied, it fails of its highest purpose. In fact, divorced from thoughts of God, it can only discourage man, because of his infinite littleness in contrast with the grand immensity of the universe, into believing that he is a forgotten atom in the dust cloud of the cosmos; or encourage him into thinking that he knows a trifle more than his fellows, and that he, with his giant(?) intellect, can delve into the profundities of space, and comprehend the infinite. Thus he is puffed up with pride and self-complacency.

Some one has said that "the undevout astronomer is mad"— mad because, with such a spectacle before him, he is still undevout. If our study of astronomy cannot put some devout thoughts and feelings into our souls, it has proved to us quite a failure.

And while this view of nature as a means of quickening faith seems a reasonable one to take as the intent of astronomical study, nevertheless there are persons who will oppose this idea. However, there are those who have gained distinction as scientists and astronomers, who view the subject in this attitude of faith and reverence. A few quotations from some of these may have an influence in starting us in the right direction.

"The great dome of the sky, filled with glittering stars, is one of the most sublime spectacles in nature.

. . . Some shine with a vivid light, perpetually changing and twinkling; others, more constant, beam softly and tranquilly upon us; while many just tremble into our sight, like a wave that, struggling to reach some far-off land, dies as it touches the shore.

"In the presence of such weird and wondrous beauty, the tenderest sentiments of the heart are aroused. A feeling of awe and reverence, of softened melancholy mingled with a thought of God, comes over us, and awakens the better nature within us."— *Joel Dorman Steele, Ph. D.*

Another has said that as we study astronomy, "the common authorship of the worlds and the Word becomes apparent; their common unexplorable wealth is a necessary conclusion."— *Henry White Warren, D. D.*

Both of the writers quoted above are the authors of textbooks on astronomy. The latter of the two did not fail, in his "Recreations in Astronomy," to carry out the principles he states.

Herschel, one of the greatest of astronomers, has said, "All human discoveries seem to be made only for the purpose of confirming more strongly the truths that come from on high and are contained in the Sacred Writings."

And General Mitchel, astronomer, and moving spirit in the building of the observatory on Mount Adams, near Cincinnati, has spoken words that should never be forgotten:

"If there be anything which can lead the mind upward to the omnipotent Ruler of the universe, and give to it approximate knowledge of His incomprehen-

sible attributes, it is to be found in the grandeur and beauty of His works.

"If you would know His glory, examine the interminable range of suns and systems which crowd the Milky Way. Multiply the hundred millions of stars which belong to our own 'island universe' by the thousands of these astral systems that exist in space, within the range of human vision, and then you may form some idea of the infinitude of His kingdom; for, lo! these are but a part of His ways. Examine the scale on which the universe is built. Comprehend, if you can, the vast dimensions of our sun. Stretch outward through his system, from planet to planet, and circumscribe the whole within the immense circumference of Neptune's orbit. This is but a single unit out of the myriads of similar systems. Take the wings of light, and flash with impetuous speed day and night, and month and year, till youth shall wear away, and middle age is gone, and the extremest limit of human life has been attained; count every pulse, and at each speed on your way a hundred thousand miles; and when a hundred years have rolled by, look out, and behold! the thronging millions of blazing suns are still around you, each separated from the other by such a distance that in this journey of a century you left only half a score behind you.

"Would you gather some idea of the *eternity* past of God's existence, go to the astronomer, and bid him lead you with him in one of his trips through space; and as he sweeps upward from object to object, from universe to universe, remember that the light from

those filmy stains in the deep pure blue heaven, now falling on your eye, has been traversing space for unnumbered years.

"Would you gather some knowledge of the *omnipotence* of God, weigh the earth in which we dwell, then count the millions of its inhabitants that have come and gone for the last six thousand years. Unite their strength into one arm, and test its power in an effort to move this earth. It could not stir it a single foot in a thousand years; and yet under the omnipotent hand of God, not a minute passes that the earth does not fly for more than a thousand miles. But this is a mere atom; the most insignificant point among His innumerable worlds. At His bidding every planet and satellite and comet, and the sun himself, fly onward in their appointed courses. His single arm guides the millions of sweeping suns, and around His throne circles the great constellation of unnumbered universes.

"Would you comprehend the idea of the *omniscience* of God, remember that the highest pinnacle of knowledge reached by the whole human race, by the combined efforts of its brightest intellects, has enabled the astronomer to compute approximately the perturbations of the planetary worlds. He has predicted roughly the return of half a score of comets. But God has computed the mutual perturbations of millions of suns, and planets and comets and worlds without number, through the ages that are passed and throughout the ages that are yet to come, not approximately, but with perfect and absolute precision. The universe is in motion — system rising above system,

cluster above cluster, nebula above nebula,—all majestically sweeping around under the providence of God, who alone knows the end from the beginning, and before whose glory and power all intelligent beings, whether in heaven or earth, should bow with humility and awe.

"Would you gain some idea of the *wisdom* of God, look to the admirable adjustments of the magnificent retinue of planets and satellites which sweep around the sun. Every globe has been weighed and poised, every orbit has been measured and bent to its beautiful form. All is changing, but the laws fixed by the wisdom of God, though they permit the rocking to and fro of the system, never introduce disorder, or lead to destruction. All is perfect and harmonious, and the music of the spheres that burn and roll around our sun, is echoed by that of ten millions of moving worlds, that sing and shine around the bright suns that reign above.

"If overwhelmed with the grandeur and majesty of the universe of God, we are led to exclaim with the Hebrew poet king, 'When I consider Thy heavens, the work of Thy fingers, the moon and the stars, which Thou hast ordained; what is man, that Thou art mindful of him? and the son of man, that Thou visitest him?' If fearful that the eye of God may overlook us in the immensity of His kingdom, we have only to call to mind that other passage: 'Thou hast made him a little lower than the angels, and hast crowned him with glory and honor. Thou madest him to have dominion over the works of Thy hands; Thou hast put all

things under his feet.' Such are the teachings of the Word, and such are the lessons of the works of God."

"Lift up your eyes on high, and behold who hath created these things." These are the divine words that are chiseled upon a marble tablet in the wall of the astronomical observatory at Williams College. No more appropriate words for such a building could be chosen. They are the prophet's call to the skeptics of his time, and they are as forceful to-day as they were then. When a French infidel said to a Vendean peasant, "We will pull down your churches, destroy your pictures, and demolish everything that reminds you of God," the peasant replied, "But you will leave us the stars."

Yes, the stars speak to us of God. The French officers could dispute and deny the existence of a Creator as they sailed down the Mediterranean beneath the splendors of the evening skies; but when Napoleon, wearied of their babble, pointed upward to the myriad stars above them, and said, "All very well, gentlemen; but who made these?" they were silent, as all atheists must be.

"Lift up your eyes on high, and behold"—this is the study of astronomy. And herein we find our field of observation; namely, that of the unmeasured universe, with its glories of shining suns and rolling worlds. "Who hath created these things?"—this is the question the study should arouse. And thus we find the purpose of astronomy; namely, to reveal the greatness and goodness of God.

CHAPTER III

Science and the Bible

WHEN, upon a cloudless, moonless night, we look above us into the overarching heavens, we are charmed by the spectacle of many points of light, scintillating and quivering in the deeps of the sky.

We say to ourselves: Can any one really tell us aught about these and how they came there? What is their purpose and what their destiny? Did they at some time come into being, or did they always exist? And what shall be their end, if any end for them there be?

It is true that science alone can partly answer some of these questions; yet some of the more important she cannot answer at all. But as we delve into these problems of astronomy, we discover that the Bible says something decisive about them. We find it speaking with authority in the realm of science. Thus we soon learn that both science and the Bible have something to say with reference to the answers; and as we carefully go to both for knowledge, we become consistent in our study of astronomy and the Bible.

For example, we ask, What is the origin of the universe? The scientist, unaided by the Word, searches all parts of the universe that are available to his tests. He computes the times or movements, the paths or directions, the powers or velocities, of the stars within the reach of his instruments. He multiplies instances. He compares one with another. He computes into the hundreds of years. He goes back in times past. He reckons forward into times to come.

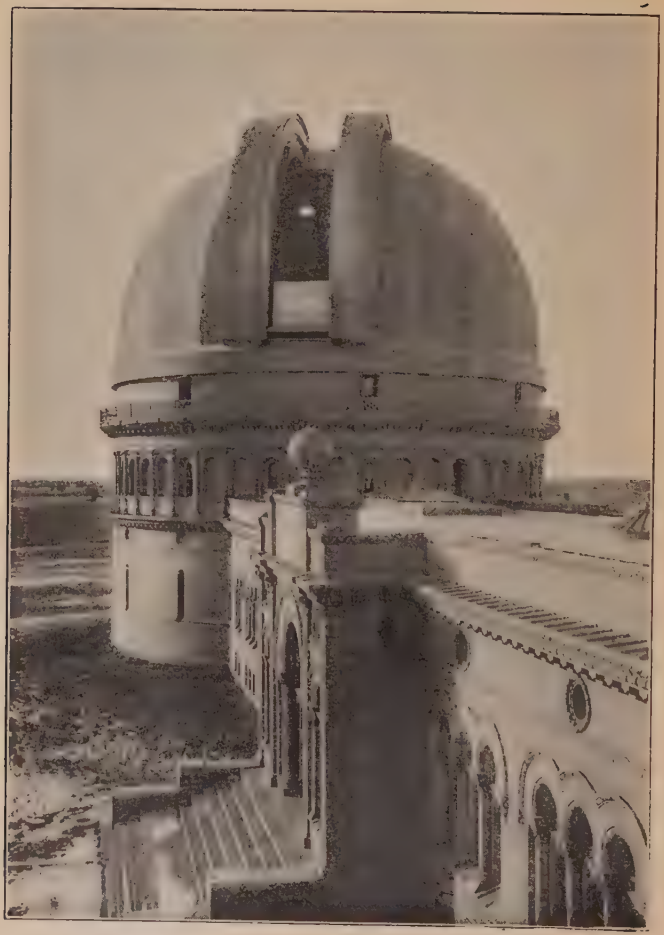
When he has satisfied every element of the problem, which is to him wholly a mathematical one, he avers: "There is no danger of collision or of interference among any of the heavenly bodies. Though their paths cross, though their orbits often interweave, yet each heavenly body always moves in such a way and place as in no wise to jeopardize itself or its fellows. Everywhere is perfect order. So far as I can see, the universe may go on as it is to all eternity. And so far as I can reckon, it has been going on in this perfect way from all eternity."

But in making this last statement, the scientist has run into controversy with the Word of God. He has contradicted the statements of the Bible. Thus we are shown that the Bible is the great guide, after all, in some of the important things of science.

In saying that the universe never had beginning, the scientist denies the statement of Genesis, "In the beginning God created." The Word admonishes us to look up and behold the manifestations of a mighty and orderly universe, but its appeal is to behold "who hath created these things." He "bringeth out their

THE SOUTHERN CROSS

This beautiful constellation is a stranger to those dwelling in the Northern Hemisphere. Note the immense company of lesser stars.



YERKES OBSERVATORY, LAKE GENEVA, WISCONSIN

host by number;" that is to say, with mathematical precision and order. He so brought them out in the beginning — created them, or gave them existence. And He still continues to bring them out; that is, maintains their existence.

Or again, the scientist asserts that gravitation holds all the heavenly bodies in place. And the Bible shows that in this, the scientist has not thought deep enough. We ask, What is gravitation? The scientist answers, Gravitation is the attraction between the particles of matter; it is the bond of relationship by which they are held together. But we press the question, What is this attraction? We find that his answer is merely a description of the thing, and really no explanation of it at all. "The attraction between particles of matter" is but another name for gravitation. What is gravitation — what is this attraction? How and why does it exist? In short, what causes the pull between the particles?

Sir Isaac Newton demonstrated the existence of the bond; yet he did not explain its mystery, but confessed to that mystery. He said that for a thing like gravitation to exist was apparently unreasonable. "How can anything be where it is not?" How can one world pull another world that is millions of miles away from it? How can it maintain an influence where it is not?

Science alone has no answer, and she has no suggestion of an answer. On a purely material basis, no adequate answer can ever be proposed. Therefore science does not pretend to answer, and she acknowledges that she does not.

But in the Bible, we learn that this power is the upholding power of the creative word. Heb. 1 : 1-3. Thus the things that are made reveal the invisible things of God, "even His eternal power." Rom. 1 : 20. Gravitation is the power of God through Christ holding all things together; that is, making them "consist." Col. 1 : 17. It is out of God's unfailing might that they endure. Isa. 40 : 26.

Even those most interested in teaching and believing some other theory, have no real argument to offer against the plain statements of the Word, except that some other explanation than that given in the Scriptures is more credible to them. One of the greatest exponents of evolution could swallow the preposterous idea that sometime in the remote ages of the past, life sprang from no-life. Believing such an unscientific, self-contradictory conception, he nevertheless admits that science can really present nothing against the Biblical idea of a personal Creator. We quote his words:

"If, . . . in some indefinitely remote past æon, the cosmic process was set going by some entity possessed of intelligence and foresight, similar to our own in kind, however superior in degree; if . . . it is held that every event, not merely in our planetary speck, but in untold millions of other worlds, was foreknown before these worlds were,— scientific thought, so far as I know anything about it, has nothing to say against that hypothesis."— *Thomas Huxley, Fortnightly Review, November, 1892.*

But though science can say nothing in denial of the Word, the Word has something to say against such

science as Mr. Huxley too often believed and taught. And true science, too, joins in the denial of his self-evident errors. How, for example, can life come from something that is not life? One of the highest laws of his beloved evolution is the law of "conformity to type"; that is to say, "Like begets like." Yet he believed — because, and only because, he needed the thing in his business — that something entirely different from life begot life.

The whole creation speaks, if it speaks at all, in a way to demonstrate the statements of the Word.

There is, for example, no possible way for us to conceive how the universe itself can maintain itself. How can each and every particle of matter constantly maintain an attractive energy for each and every other particle of matter? How can this mighty flow of power be maintained undiminished throughout the ages? We cannot conceive of such a flow without an idea of an adequate source from which it flows.

Again, the heavenly bodies are all in motion. That motion is unceasing from age to age. The average is constant. In the case of the rotation of the earth on its axis, causing day and night, there is not the slightest variation in velocity, not by the fraction of a second.

We know how difficult it is with us to maintain motion. We must have some supply of energy by which to accomplish it. But the stars drive on through space with untiring power. Can they drive themselves? Even our automobiles, "self-moving machines," are in reality gasoline-moved machines. They

must be constantly supplied with the source of energy; and after a given length of time, the mechanism breaks down.

We say again, On a material or mechanical basis alone, there is no real explanation for this living, stirring universe.

Take again the problem of the direction of the stars. We *see* that everywhere there is wonderful order. The universe is a delicately adjusted unit. Every part is placed with perfect reference to every other part. All are guided by perfection of wisdom. Where does this wisdom reside? Does each sphere contain its own intelligence? And if so, whence came it, so that it should comprehend the entire universe, and be always perfectly related to all the activities of the cosmos?

Then, too, there is the question, unanswered by science, concerning the mystery of radiant energy. The light of the stars shines on in unfailing luster from age to age. What feeds the fiery flames?

And with all the rest of the marvels, we contemplate the wonder of the speed of light. It moves with the enormous rapidity of 186,000 miles a second. That is a distance equal to about 7⅗ times around the world. And all this in a second of time! One swing of the pendulum, and light has swung 186,000 miles away. Before you have read this sentence, it has traveled more than 800,000 miles.

And the speed does not slacken with the distance traveled. A man or a horse travels slower as the distance increases, until, without rest, motion ceases alto-

gether, the energy is exhausted. But light is still speeding 186,000 miles a second when it has traveled a thousand years. Time or distance makes no change in its velocity.

There is a star yonder in the heavens. To come from it to us, light must travel day and night for a hundred years. When light left that star, it was traveling 186,000 miles a second; and when it reaches the earth after its century flight, it is still traveling 186,000 miles every second. There is no slowing up with the distance traversed.

A fact like this can never be explained on any purely material or mechanical basis. The cause of all this flow of unflagging energy lies far back beyond the measure of yardstick or balance arm, of telescope or prism glass.

God is the cause of all, and He is invisible both to the eye of man and to the instruments that man may devise. Yet in the realm of spirit, we may seek and find Him. He may be discovered by the eye of faith. We may know Him not only as Originator and Upholder, but as God and Father. And finding and knowing Him, we find and have the life eternal.

Thus we see that the Bible and science should not be separated. Yet some may ask, In just what sense does the Bible aid in the study of science?

In answering the question, shall we assume that the Bible has nothing to do with science, and that science has nothing to do with the Bible? Shall we accept the position of Hugh Miller, the celebrated geologist, that the Bible does not in any sense reveal the great

physical truths of nature, that science alone is fully competent to discover these, and that therefore God "left them to be developed piecemeal by the unassisted human faculties"?

Not by any means.

We have found that those scientists who say that the Bible and science have nothing to do with one another are radically wrong. We know that certain so-called scientific teachings are constantly coming into clash with the statements of the Word. This of itself must show that the Bible does say something on the question; otherwise there would be no controversy.

Yet, while it is perhaps recognized or acknowledged that there is some sort of relation between the two, there is seen to be also some sort of distinction or division between them.

Now, the Bible, we know, does not answer all the questions we might ask concerning nature. The Bible does not record the distance from here to the sun. It does not record the number of petals in a sweetbrier rose, nor does it describe the notes of a lark.

If these things are not found in the Bible, where are we to find them? — In nature, of course. It is nature's work to show forth facts. Nature is, indeed, but a cosmos of facts or realities. And facts can best be learned by observation, by acquaintanceship with them. How could words present to you the song of the lark? How could descriptions reveal the tender, ravishing color of the rose?

But though nature teaches us facts, great guiding principles, on the other hand, may be stated to us in

words. And this is what the Bible does for us. The Bible contains the great principles that concern our salvation. We may study the facts of the natural world; but when we seek to formulate a principle that affects man's relation to his Creator, we at once come within the jurisdiction of the Word of God.

And we assert, without fear of successful contradiction, that wherever and however men draw conclusions regarding the relation between God and His creation, right there, always and forever, will be found something from God's Word confirming or denying the human conclusion.

This is infallibly true.

Fact is conformity to truth. When God stated the infinite truth of the Word, He saw all the facts of the universe that lay within the meaning of that truth, and God's statement did not contradict a single truth, and there was not a fact in the universe left unexplained by the truth. Truth is conformity to fact, and fact is conformity to truth. The Bible is "the truth," and nature consists of facts; and so there is perfect conformity between the Bible and nature. The facts of nature illustrate the truth of the Bible, and the Bible guides us in our contemplation of nature. Thus each illuminates the other.

The Bible gives us, if you please, the working hypothesis regarding all the fields of knowledge. If we attempt to unite truth with error, or good with evil, the statements of the Word drive a line of cleavage between the two, separating them for us. Thus we are kept from being ensnared. We are saved from

error, which is the perversion of truth; and we are saved from evil, which is the perversion of good.

The study of astronomy in the light of the Bible is therefore the only rational study of it. By a contemplation of God's Word and His works, we shall rise to a measure of real knowledge. We shall constantly attain both wisdom and judgment. Thus we shall never lose reverence for God nor confidence in His Word.

CHAPTER IV

The Atmospheric Heavens

NO one can have any adequate idea of astronomy without some knowledge of the atmospheric heavens. The ignorant in past ages may have thought that the heavens encircling us were but plates that held us in, parts of a huge crystal sphere.

Had the Bible expressed this childish idea, that would at once suggest to us an earthly origin for the book; but though it was written in times when all sorts of queer ideas were current, yet it is nowhere contaminated by the folly of the times.

Its pure stream flows unsullied down the ages. Its adherence to truth is so close and unbroken that the lives of some of its greatest men are told in all the sorrow and shame of their sometime lapses into sin.

When the English translators a few centuries ago rendered the Bible into English, they sometimes used words more in harmony with their own ideas of science and theology than with the original terms.

One example of this is found in the first chapter of Genesis. "God made the firmament, and divided

the waters which were under the firmament from the waters which were above the firmament." Gen. 1:7. Thus, in a few words, the Bible records the creation of that which scientific men call the atmosphere. It gives a very simple description of a very complex thing, yet it opens the very heart of the wonderful fact.

This scripture, as well as the whole narrative of creation, is intended for the instruction of all mankind, and not of the learned reader only. Also, it is intended for all mankind in every age of the world's history, no matter what relative knowledge of science that age may possess.

For a book like the Bible, addressed to the souls of all mankind whatever their educational attainments, no other course is possible or permissible. The language must be so simple, must so touch the root idea of things, that any man, or even a child, can gather some knowledge of its meaning. At the same time, the wording must be so clear and pure that no scientific attainments, however great, shall ever be able to reveal defect in it or to supersede it.

Such, we shall find, is this statement concerning the creation of the atmosphere.

There have been times when men believed and taught that the earth was flat. They thought then that the heavens were a crystal dome resting on all sides upon the firm support of the earth.

And some men in our days seek to show that the word "firmament" of the Scriptures means this same thing. One writer, greatly impressed with his own

narrow conceptions of the ancient Book, translates the word "hammered plates." In so doing, he shows more invention than knowledge.

The word *raqia,* from which "firmament" is translated, is from a root word meaning *to hammer* or *pound.* The idea of "plates" is not in the original word. It was wholly supplied by this modern skeptic. To hammer metal out into plates is to cause it to expand; and so in time the word which at first meant only *to hammer,* came to mean *to expand.*

Thus in the Hebrew language, the word has two meanings; one, *to hammer;* and the other, *to expand.* And that which was expanded was called *raqia,* an expanse. But not once in the Hebrew Bible does this word stand for our two English words "hammered plates." In fact, there is no such expression as "hammered plates" anywhere in the Bible. The nearest like it are the terms "beaten gold" and "beaten work"; but for these, entirely different words in Hebrew are used.

The only suggestion, in the Hebrew, of the idea given in the crude translation of the modern critic is found in two expressions. Thus in Ex. 30:3, we read of gold beaten into thin plates. But here the root word appears in order to represent the spreading out of the metal by the beating, and a separate word is used for "plates." The other example is Isa. 40:19, where the goldsmith is mentioned as spreading an image over with gold. But it is for the "spreading over" that the root word is here used, and not at all for the metal, which is indicated by another word.

One can readily see that since the word means that which is expanded, it might possibly have been used to designate a metal plate so expanded; yet not once has inspiration so used the word.

But when we examine the term "expanse" as applied to the atmospheric heavens, we discover a deep and great significance to it. We understand that air is made up of a mixture of two gases, oxygen and nitrogen; and we know that all gases tend to expand unless in some way confined or restricted in space. Furthermore, science teaches us that the expansion of any gas is caused by the hammering upon one another of the atoms of which the gas is composed. We do not aim here to condone the atomic theory; but supposing that science is somewhat right, we begin to see how the idea of "hammer" might come into the word denoting the atmosphere. All matter, and particularly gaseous matter, is vibrant with force; and force is but the energy of the creative word.

When God, therefore, wrapped the earth about with a gaseous envelope, vibrant under the constantly impressed energy of the word, the very vibrating and clashing and hammering of the atoms of the gases, particularly under the heat of the sun, caused these particles to seek wider room and thus expand until the stress of expansion was in perfect balance with the restraining stress of gravity.

And thus it is even to this day.

We can picture how, when God created the constituent gases of the air, they moved out into a great atmospheric expanse, to the bounds fixed for it by the

will of the Creator. Thus we have a hammered expanse; for the particles of the gases have been hammered by the energy of the creative word. And we have even now a hammered expanse; for the power of that word is forever active, still causing the particles to vibrate and thus continue to maintain the expanse. The first impulse from God created the air; the second impulse continues and maintains it.

We do not deny, for it is true, that men came in time to think of the sky as a dome of crystal. Thus the Greeks and the Romans viewed it. The Jews even, by contamination with the heathen — and the New Testament record is proof enough of their final apostasy — might give the Scriptures an improper rendering. But this is all apart from the work of inspiration. And to-day we see the result of heathen ideas, the result of a misunderstanding of the works as well as the Word, in our common English translation of the word *raqia* by "firmament," as something firm or substantial.

But we cannot believe that Abraham had this restricted idea of the heavens when the Lord led him abroad at night and revealed to him that the stars of the sky were not merely a few thousand, as his unaided eye would think, but that they were as numberless as the sands of the ocean shore. They were, as Abraham found when God strengthened his sight, beyond the count of man. How could such a conception accord with the idea of some shining plates holding within their walls a few lights? Leave such foolish ideas for the heathen to hold, but charge them not to the seer of

God. When Moses speaks of "the heaven and the heaven of heavens," he is saying, according to the real meaning of the Hebrew, "the lofty and the lofty of the lofties"; and by this, we know that he means something far beyond any heathenish idea of a low dome above us. Deut. 10:14. The prophet Jeremiah brings to us the revelation that the heavens above cannot be measured by man (Jer. 31:37); and this of itself disposes of any such limitations to the sky as the heathen held. Immediately afterward the same prophet could appeal to this might of God in creating an unmeasured expanse above us and about us, as a proof of God's omnipotence. Jer. 32:17. Men's ideas of God's Word, and that Word itself, are quite separate things. Revelation gives us the truth of science, the real fact, in the word "expanse"; and science is left to search out the details which revelation thus suggests. Here we see again the concord between the Bible and science, their true harmony.

Last of all, the Scriptural word for "atmosphere" is better than the one that science gives. The language of science is more the language of mere appearance. Thus books on astronomy speak of "the sun entering Aries," by which they do not mean that the sun actually enters the constellation of Aries, but that it passes a certain point in space, called "the vernal equinox." They also speak of the conjunction of heavenly bodies, but do not mean by this that these bodies actually conjoin; they merely appear to do so. And scientific men, nonscientific men, and the Bible also, put the appearance for the reality, when they

speak of the rising and the setting of the sun. It is perfectly proper to use such an expression; for we speak of the phenomenon only, without any reference to the cause producing it. To do otherwise would be to place upon us a burden that neither we nor our language of common conversation could bear.

We have said that the Scriptural name for the atmospheric heavens is a better word than that given by science; and so it is. The word that science gives, means "a ball of vapor." It describes the appearance of the thing. But the Bible word suggests the real condition and nature by using the word "expanse," suggesting to us the inner fact, and prompting us to learn what was expanded, and what caused this expanse.

A tree is known by its fruit. The Word of God does not give men narrow, foolish ideas of even this material universe. It gives us, indeed, the mightiest of spiritual truths; but its words regarding the material creation, though fewer and briefer, are so grand and so sublime as to comport with the first.

The Bible has given the germ truth of all the great scientific discoveries of these modern times. As we proceed with the subject, this will be more and more clearly discerned. These principles of the Word hold true even in the fields of mathematics, physics, chemistry, and biology. If men had used the truth of God's Word as a basis of scientific investigation, there would to-day be seen a far better state of affairs. But religion, too often, has been made the means of fettering men's souls rather than of freeing them. This

must be laid at the door of bigotry and priestcraft. It is not the influence of the Bible.

Take another example of the inerrancy of the Word:

Men have always known something of the air. It has propelled their ships, thrust itself against the bodies of men, and overturned their works. But the great reason for all this, the great principle by which these atmospheric phenomena are to be explained, had never once entered their heads. They witnessed even the devastation of the whirlwind, but never once dreamed that weight was necessary to give momentum. They could only attribute the work to some of their idol gods. And so long as men did not think of air's having weight, they would not, of course, make any investigations in that direction. At last, however, the question was raised. Men asked, Has the air weight? How this question first arose, no one now can say. Possibly it was suggested by the phenomena themselves. If so, the facts of nature were pointing men toward the truth. Or it may be that men read Job 28:25, and then went to nature with the question. If so, it was the Word leading men to the facts that explained the truth of the Word. How one could read this text in Job and not have the question suggested, it is not easy to understand. But in some way, at last, the question was raised, Has the air weight?

"During the earlier period of the revival of learning in Europe, the question was occasionally discussed, and was always decided in the negative. No such pressure could be *felt. All experience and sensation seemed to be opposed to the idea of its existence.*

A Peculiar Nebular Formation in Cygnus

Region of the North American Nebula

Vast numbers of stars, most of them larger than our sun, that stagger the imagination, and overwhelm the reason. In their midst is the weird, mystic nebula. Note the peculiar outlines that give it the name.

"Men were everywhere using their rude devices for raising water in pumps, without the least idea of what they were doing. The action that was taking place before their eyes never entered into their comprehension. If any one had told them that, in raising a pump bucket, they were lifting a portion of the weight of the atmosphere from the water under the bucket, so that the excess of this pressure, exerted on the surface of the water in the well, would force the column of water in the pump barrel up after the bucket, there were centuries when such a teacher would have been in danger of being burned up.

"This, with all similar phenomena, was explained by the dictum that nature abhors a vacuum. This nonsense passed for science through many ages. It is interesting to recall the long period during which this was assumed as an axiom that no one dared to question. . . .

"The raising of the question whether the atmosphere might have weight, was itself a notable event, as marking the beginning of scientific inquiry. But an experiment was made, which was long regarded among the learned as settling this question in the negative. This experiment consisted in weighing a bladder, when distended with air and when empty. No difference could ever be detected."

Men did not see the fallacy of this experiment.

"This fallacy lay in the unobserved fact that the bladder was filled with, and immersed in, the same fluid. Whether full, or approximately empty, it always displaced, in addition to its own proper bulk, very

nearly the same weight of air that it contained. A similar experiment would just as well prove water, or even mercury, to be without weight. So this great fact was hidden from men. Copernicus, Galileo, died without the sight."

Though God had said, ages before, that He had given to the air weight (Job 28:25), men trusted the result of their own blind guess instead of the infallible Word of God. So they were still in error.

"In endeavoring to raise water from a deep well in Florence, it was found possible to lift it only about thirty-two feet, which led Galileo to observe that nature, evidently, did not abhor a vacuum above thirty-two feet. Dying, Galileo commended the investigation of this subject to his pupil and successor, Torricelli. The reflections of Torricelli led him to the conviction that the atmosphere must have weight [he had found the true theory, the one given in the Bible], and that it must be by its pressure that the water was caused to rise in the pump barrel. In considering how this question might be tested, he at last thought of mercury. This substance, between thirteen and fourteen times heavier than water, would be caused by the same pressure, if it existed, to rise only about thirty inches. So he reasoned that, by the employment of mercury, the existence or nonexistence of this pressure might be shown in a glass tube.

"It is interesting to imagine the feelings of this philosopher when preparing for this experiment, which was so remarkable at once for its simplicity, its conclusiveness, and its importance. It was almost as

simple as that of standing the egg on its end, yet no other finite mind had conceived it. Was it with trembling expectation, or in the calmness of conscious strength, that he filled with mercury his glass tube, four feet in length, sealed at one end, placed his finger over the open end, inverted the tube, plunged the open end in a vessel half filled with mercury, and then — removed his finger?

"What were the emotions with which he saw the column of mercury fall, and, after completing the oscillations produced by its momentum, stand at a height of between twenty-nine and thirty inches, in equilibrium with the pressure of the atmosphere on the same area of the mercury in the vessel; or with which he realized the fact that the glass tube above the column of mercury inclosed the absolute void, then first obtained by man, since only approximations to it could be reached in the pump barrel, and which was ever after to be known as the Torricellian vacuum! And what would his emotions have been if he could have imagined — what, indeed, no one can adequately conceive — the influence that this discovery was to exert in prompting the industries and the civilization of his race!

"The discovery of the pressure of the atmosphere is one of those discoveries by which the boundary of human knowledge has been enlarged in a remarkable degree. It was a *radical* discovery; and out of it there have sprung an endless series of discoveries and inventions, which, while they have contributed to an incalculable measure to the welfare of man, have at the same time still further added to the extent of his

knowledge and the power of his understanding."—*Charles Talbot Porter.*

We know that the weight, or down pressure, of the air, is enormous. Its pressure, or weight, is about fifteen pounds to the square inch, or over a ton for each square foot of the earth's surface. This is not felt; for it is through us as well as about us; we are immersed in it. The whole pressure of the air on the surface of the earth, expressed in tons, would require sixteen digits. In round numbers, we may say, it is five thousand millions of millions of tons; or if you want it more exactly, it is close to 5,517,823,961,480,000 tons.

Thus we know that the weight of the air is tremendous. God gave air this weight. He regulated it with mathematical nicety to our needs. And He did not leave us in ignorance of the fact, but told us of it in His Word. The air binds the earth with an elastic hoop. If God were to unclasp this air from about the earth, and take off this enormous pressure, would not the pent-up forces within the earth break forth? Some day He will remove it, as one removes the peeling from an orange. Some day it will be rolled together as a scroll. Rev. 6:14. What about your science then? Will you, with all your science, be founded on His immutable Word? If so, you may look calmly up, in that awful hour, and say, We will not fear, "though the earth be removed, and though the mountains be carried into the midst of the sea; though the waters thereof roar and be troubled, though the mountains shake with the swelling thereof."

CHAPTER V

The Power of Gravitation

THE work of Sir Isaac Newton in ascertaining that there is in the universe a mysterious force acting between all particles of matter, regardless of how remote, and his work in measuring the pull of this power between given bodies, is something no man should belittle. What he accomplished speaks for itself in the gigantic results that have followed.

Yet this was but a development of things already grasped by the inquiring mind of man. For years, men had used pumps; but had they been told that the mechanism of the pump, thoroughly understood, would explain the force operating between the heavenly bodies, the announcement would have been met with absolute incredulity. Yet solving the problem of the pump led to the discovery of the fact that air *has weight;* and from this, men came to the conclusion that all things have weight. But this is universal gravitation, only put in other words.

"Out of pumps grew the discussion about nature's abhorrence of a vacuum; and then it was discovered

that nature does not abhor a vacuum, but that air has weight; and that notion paved the way for the doctrine that all matter has weight, and that the force which produces weight is coextensive with the universe,— in short, to the theory of universal gravitation and endless force."— *Thomas Huxley.*

We have found in the Word an announcement that air has weight. Since the truth of a coextensive force lies in that revelation, it follows that so far, at least, gravity is pointed out. But the Scriptures are plainer and more explicit regarding gravity than this; for that there is such a force is more than once declared.

The Bible places before us a very striking picture. The apothecary, in filling a prescription, or in compounding a mixture, first measures out the materials. He then knows in just what proportion the ingredients are used, and the combined weight of the whole.

That such a picture with reference to the Creator should be given us in the Word of God ages before the so-called discovery of Newton, is most significant. The Creator is represented as weighing out and measuring, when He established the universe, all the elements that enter into it. He is represented as knowing the weight of all the different parts of the earth, even as a man knows the weight of the parcels he places in the scales.

"For He looketh to the ends of the earth, and seeth under the whole heaven." Why does the Creator do this?—"To make the weight for the winds; and He *weigheth* the waters by measure." Job 28:24, 25. "He made a law for the rain, and a way for the sound-

ing storms." Job 28:26, Douay version. Again: "Who hath *measured* the waters in the hollow of his hand, and *meted* out heaven with the span, and *comprehended* the dust of the earth in a measure, and *weighed* the mountains in scales, and the hills in a balance?" Isa. 40:12.

This is but *one aspect* of the great law of gravitation. Scientists now see that any atom of the universe is assigned to its place with a recognition of what effect it will have on every other atom, and what effect every other atom will have upon it. With all other parts of the universe as they are, and the earth's orbit of the size and in the relative position that it is, the weight of the earth could not be increased or made less without most serious consequences not only to the earth but to the whole universe.

Let us look more closely at this matter for a moment. Suppose the earth to have its present distance from the sun, and its present orbital velocity of motion.

According to the first law of motion, a *moving body* left to itself moves forever in a straight line, with a uniform velocity.

Now the earth has been set in motion with a velocity of about eleven hundred miles a minute. But as has been said, if left to itself, the earth would move in a straight line.

However, the earth does not move in a straight line, but instead, moves in a path nearly circular, or what is called a closed orbit. The attraction of the sun is the force that deflects the earth from a straight path and gives it this orbital direction.

But the attraction of the sun is determined, outside of the sun itself, by the amount of matter in the earth. If there were somewhat less matter in the earth than there is — that is, if the earth weighed slightly less than it does now — its orbital velocity being as now, the attractive power exerted by the sun would be weaker than it is now, and the earth would not be sufficiently deflected to move in a closed orbit around the sun.

With every revolution, the earth would be farther away from the sun, until at last, breaking away from the sun's control, it would fly out on a career of its own into the wilds of space.

If, on the other hand, the earth weighed slightly more than it does at present, and its orbital velocity were unchanged from what it is now, the attractive power of the sun would be greater than it is at present, and the earth would be deflected inside of its present orbit.

At each revolution, it would approach nearer and nearer the sun, until eventually, with a frightful speed, it would crash into the great central luminary.

But either of these supposed circumstances could but work ruin with all other parts of the solar system. And what happens in the solar system must be felt to the outermost bounds of the unfathomable universe. If one member suffers, all others must suffer with it.

The universe, grand and infinite as it is in its expanse, nevertheless is a unit. And it is made a unit by this power which acts between all its component parts. This force is the hand of God, so to speak,

which holds each element of the whole in its relative place, and guides all in their infinite paths.

The Word declares that, even as men have now found, the earth hangs on *nothing*. "He stretcheth out the north over the empty place, and hangeth the earth upon nothing." Job 26:7. But it is just as explicit in declaring that the earth is nevertheless upheld. Furthermore, it declares that all things as well are upheld. And it even affirms *how* the earth and all things are upheld. Scientists are right in attributing this work to a force. So the Bible attributes it; but the Bible goes a step farther, and gives the cause and origin of this force, ascribing it to the word of almighty God. *"Upholding all things* by the word of His *power."* Heb. 1:3.

When we read the scriptures in Isaiah where God is represented as measuring the waters, meting out the heavens, comprehending the dust of the earth, and weighing the mountains and the hills; when we read that He not only measured these, but determined their specific gravity and total weight (Job 28:25; 38:4-7; Hab. 3:6),—we are so struck with the greatness of the Creator, that all other ideas in the Scriptures seem to fade out of view. We find it so great a revelation of God, that we stop with that revelation, and go no farther. But that is not all there is in the disclosure. As we have seen, the fundamental truth of universal gravity is included in the greater revelation of God.

When, on the other hand, we study what science has done, we see only the great revelation of gravity; and looking no farther, we fail to see a revelation of God.

But it was not designed that, having seen the workings of infinite power, we should cease our investigations, until we had come to the all-sufficient source of that infinite power.

Thus viewing the *Word,* we have seen the God of power, but have failed to study the workings of that power; and viewing the *workings* of that power, we have failed to perceive the God of the power. Which mistake is the greater, we need not discuss. God meant us to make neither. A free knowledge of God must in time lead us to a knowledge of His workings; and an ignorance of God, as in the Dark Ages, must produce ignorance of His workings — that is, stagnation in science and in scientific researches.

But let no one think that any theory of gravitation will be complete which leaves out of consideration the great Primal Cause. That there are absurdities as well as things beyond human conception in the hypothesis scientists have adopted with reference to this power, all scientists know.

How some of them feel about these difficulties is well stated in the following words:

"We must not imagine the word 'attract' to mean too much. It merely states the fact that there is a *tendency* for the bodies to move toward each other, without including or implying any explanation of the fact. So far, no explanation has appeared which is less difficult to comprehend than the fact itself. Whether bodies are *drawn* together by some outside action, or *pushed* together; or whether they themselves can act across space with mathematical intelligence,—

in what way it is that 'attraction' comes about,—is still unknown,—apparently as inscrutable as the very nature and constitution of an atom of matter itself; *it is simply a fundamental fact."—Young's "General Astronomy."*

The Bible has its part in revealing the truth of the attraction of gravitation. It declares:

1. That there is such a power;
2. That it upholds all things; and—
3. That the causative agent is the word of God.

On these three points it stands, above all science and scientific research; and it always must, in the very nature of the case, so stand. Science only shows its utter folly and weakness when it attempts to enter this domain of the Word with any other doctrines and philosophies.

But in that matter of the study of gravity, science has its lawful and helpful place. There are some *facts* involved in the great *principle* announced in the Word. Just what these facts are cannot be ascertained by a study of the Word alone, or by the Word at all; they are not there revealed. Only the truth is there revealed; the facts are revealed elsewhere. The facts must be found by a study of the works. And only by a study of the works can they be found.

The facts which science may discover and announce, and which, indeed, it has found and made known, are two: namely, that this force of attraction between particles is (1) directly proportioned to the mass of the attracting particles, and (2) inversely proportioned to the square of the distance between them.

The *first fact* may be stated thus: The power acting between bodies of equal mass increases when the number of particles is increased, and decreases when the number of particles decreases. That is, the power acting is always proportioned to the number or mass of the particles it acts upon.

As to the *second fact:* When we increase the distance between particles, we decrease the pull between them; and when we decrease the distance between particles, we increase the pull. That is, the pull is *inversely* proportioned to the square of the distance between the things pulled.

These two facts, and what they mean, are well stated by Henry White Warren, D. D. We make a slight change in the wording, to fit our purpose. "The laws governing this attraction are two. When these particles are associated together, the attraction is in proportion to the mass. A given mass pulls twice as much as one half the size, because there is twice as much to pull. And a given mass is pulled twice as much as one half as large, because there is twice as much to be pulled. A man who weighed one hundred and fifty pounds on the earth might weigh a ton and a half on a body as large as the sun. That is one law of attraction; and the other is, that masses attract inversely as the square of distance between them. Absence affects friendships that have a material basis. If a body like the earth pulls a man one hundred and fifty pounds at the surface, or four thousand miles from the center, it will pull the same man one fourth as much at twice the distance. That is, he will weigh, by a spring bal-

ance, thirty-seven and a half pounds at eight thousand miles from the center, and nine pounds six ounces at sixteen thousand miles from the center, and he will weigh or be pulled by the earth one twenty-fourth of a pound at the distance of the moon. But the moon would be large enough and near enough to pull twenty-four pounds on the same man, so the earth could not draw him away. Thus the two laws of attraction are: *(1) Gravity is proportioned to the quantity of matter; and (2) The force of gravity varies inversely as the square of the distance from the center of the attracting body."*

Now these two facts belong to the domain of science. Men are left entirely free to know all that they may be able to discover regarding these. The Bible is utterly silent relative to them.

But to the three points which revelation declares, science is allowed to add all that it may by way of illustration. Man is invited to reëcho the words of God by working. The Bible says (1) that there is a universal force acting in the universe, and (2) that it upholds all things, and (3) that it is due to the power of the word of God. Science may in any legitimate manner reaffirm and reëcho these truths of God. But the two facts discoverable by science, the Bible in no way attempts to state or name. In other words, the Word invites confirmation of its statements, but leaves science entirely free in the investigations which belong to its own peculiar domain.

Thus there are two fields of knowledge,—one for revelation, the other for science. There should be no

conflict between them. Each is helpful to the other, and each sheds light upon the other.

And this is an example of all other fields of knowledge. God has done His part, and done it so well that no man can in truth condemn or amend it. He gives man also a part to act, and a field of knowledge to work, *to which* the Word will give him infinite aid, but *in which* he is left by it profoundly free. And as man labors, acting well his part, he may some day come to know that he is even thus a laborer together with God, and that in this wider knowledge lies a broader liberty.

CHAPTER VI

The Transfer of Energy

THE book of Job contains many references to the things of the material world. The Creator, in the closing chapters of the book, lays before the puzzled Job some of the fundamental problems of science. The reason of this is easily discovered.

Job had been sorely afflicted. Bereft of family and all earthly possessions, suffering of a loathsome disease, he is at length visited by three of his friends. The three know but one philosophy: Suffering is always on account of sin, and is ministered in exact proportion to the enormity of that sin. If a man is well and prosperous, that is evidence of his righteousness; if he is afflicted, that is proof of his sin.

The three do not see in Job any semblance to his former self. They lift up their voices and weep, rend their mantles, sprinkle dust upon their heads, sit down upon the ground seven days and seven nights, offering not a word.

At last, the suffering of Job becomes so great that he curses the day wherein he was born. The three

listen to him for a time; but eventually their pent-up feelings find vent, and their philosophy that suffering is always visited because of sins committed, is poured out in words and figures and arguments in overwhelming confusion upon the miserable Job. "Who ever perished," say they, "being innocent? or where were the righteous cut off? . . . They that plow iniquity, and sow wickedness, reap the same."

But Job knows that such philosophy is not complete; he knows, even as the facts in the case attest, that their words do not apply to him. Nevertheless he is groping in the dark. He does not understand the meaning of his condition. He knows, however, that he is innocent of any evil intent or deed. Then begins the long and heated argument. The three counselors are silenced at last, and a fourth, named Elihu, attempts still further to clear the mystery.

None of Job's comforters would admit that the innocent could suffer, or the righteous be afflicted. The bright light from the cross had not as yet lighted the mystery. In Christ, we see the innocent afflicted, and the upright suffering death. Job was, though he knew it not, but filling up "of the afflictions of Christ." Col. 1:24. All unconsciously, he was fellowshiping in the sufferings of Jesus.

Then when Job's darkness had grown most intense, and the problem of his condition seemed incapable of a solution, God appeared. In His address to Job, He taught the afflicted man that this mystery of the innocent suffering for the guilty was only one of the many great problems that confronted the pygmy mind of man.

THE LAND OF THE MIDNIGHT SUN

As the earth might appear if one could only "stand off" and look at it when the sun is "farthest north."

A Typical Sun Spot — Highly Magnified
Photographed from a drawing by Scriven Bolton.

In imagination, He carried him back to creation's morning, then out into the great universe, and finally brought him to the simplest, most familiar things of the world about him, causing him to realize that everywhere are questions unanswered and problems unsolved — mysteries too high for man's mind in this his infant state and in these his few years of sojourn.

But if he could not solve intellectually the problems of his life, Job, face to face with the Creator, could realize God's love and goodness, and at once resigned himself to the peace and holy shelter of the everlasting arms.

The Creator's questions to Job call to our minds some of the mysteries all about us. These mysteries mean, first of all, that there is still something more for us to learn, a mine of riches as yet all unexplored. These mysteries should teach us modesty, and produce in us, while we grope and ponder, a willingness to wait for the full unfolding of the truth.

Much has been said and written concerning light. Many think it is quite fully understood. But it is not. In some of its simplest aspects, it is still a profound, impenetrable mystery. God, when He appeared to Job, asked him the still unanswered question, "By what way is the light distributed?" Job 38:24, literal translation.

Some in our day would say that the answer to this question is very simple. "Light is distributed," they say, "by vibrations, or waves, in the luminiferous ether." And then this lucid definition is explained somewhat as follows:

As a pebble, dropped in water, causes ripples in the water to travel outward across the surface, so notes and tones cause vibrations, or waves, in the atmosphere; and these, reaching the ear, set up a vibration of the drum of the ear, causing at last a sensation of sound. In a similar manner, a vibration in the ether, reaching at last the eyes, gives one the sensation of light.

But all this being said and understood, the fact still remains that no one can explain how light reaches across an intervening space. We cannot, even now, with all our boasted science, answer the question God addressed to Job; and the conviction grows that it is unanswerable — the simple question, "By what way is the light distributed?"

And this mystery of the transfer of light is also the mystery of the transfer of gravity, electricity, heat, and all radiant forces whatsoever. We know, in some measure, what these forces do; but how they do it is a question as yet very imperfectly answered.

"We must carefully bear in mind that the origin of phenomena is not explained because, in the language of science, they have been referred to an assumed force with a high-sounding name. Names are not things; and we know nothing more of the cause which brings the apple to the ground because Newton has called it the force of gravitation, than we did before. He gave us the law of motion, and showed us the formula of its working, and enabled us to predict how every apple would fall, and how every planet would move throughout space; but the cause of the motion is as closely

hidden as ever. In regard to the law of gravitation we know a great deal; but in regard to the force of gravitation — whatever we may think or believe about it — we know absolutely nothing, and the same is true of every other force."—*Josiah Parsons Cooke, Erving professor of chemistry and mineralogy in Harvard University.*

Newton, over and over again, insisted that he had nothing to do with gravitation as a physical cause. He said: "How these attractions of gravity, magnetism, and electricity may be performed, I do not here consider. What I call attraction may be performed by impulse or by some other means unknown to me. I use the word here to signify only in a general way any force by which bodies tend toward one another, whatever be the cause."—*"Optics," query 31.*

"Newton assuredly lent no shadow of support to the modern pseudo scientific philosophy which confounds laws and causes."—*Huxley.*

"All we know about the force of gravitation, or any other so-called force, is that it is a name for the hypothetical cause of an observed order of facts."—*Huxley.*

Huxley calls this force a hypothetical cause. "Hypothetical" has reference to a hypothesis; it is something "assumed without a proof, for the purpose of reasoning and deducing proof." But a hypothetical cause is, in the absolute sense, no cause at all. Forces are not causes; for they themselves in turn must be accounted for. Notice how it works: Bodies tend to move toward each other; what is the cause? "The force of gravitation," says the scientist. But what is

this force?—"It is the force which draws bodies toward each other." But how does this force produce this effect? Coming back to our first question, what is the cause of this attraction? Our question remains unanswered. While we search for the cause, the pseudo-scientist continues to repeat his formula, "Bodies are attracted toward one another by the force of gravity; and the force of gravity is that which draws them together." He ends where he began, and he begins where he ended. He is reasoning in a circle.

"It is certain that light consists in the transference of energy, not of matter; and the undulatory theory is based upon this fact. But as to the manner in which energy is thus transferred, we are entirely ignorant."—*"International Cyclopedia," article "Undulatory Theory of Light."*

How do light and the force of gravitation travel across the abyss of space? In the words of God to Job, "By what way is the light distributed?" Scientists cannot tell. The theory that light travels by vibrations in the light-bearing ether does not explain it. The theory, in its very constitution, is self-destructive. By this theory, one thing is supposed to act upon another through a space absolutely empty.

To see more clearly how difficult is this question of the transfer of force through space, let us take, as an example, the light and heat of the sun. The sun acts upon us to produce the sensation of light and heat. The sun is over ninety millions of miles away from us; and the light and the heat are here on the earth, having traveled the immense distance from the sun

to us. We find that the light and the heat, in passing from the sun to us, have consumed some eight minutes.

Now, in this instance of the transfer of light and heat from sun to earth, we have the idea of a motion — the motion of this force passing from sun to earth. But in conceiving motion, we always think of something moved. Therefore we argue that the exercise of force through ninety millions of miles, or through any other distance, for that matter, of absolute vacuum, where there is nothing that can in any wise be moved, is inconceivable. We cannot think of a force as traveling unless it has something in which or upon which to travel. Hence we naturally reason about as follows: Between the sun and the earth there is a motion shown by the transfer of heat and light, and hence something moved. This something that moves, and hence transfers the energy of light and heat — what is it? Scientists call it the ether. Some of them think it is a sort of thin air; others think it is an elastic solid, which pervades all space, being always present everywhere. As has been said, waves in the ether are supposed to carry the energy of light and heat, somewhat as the air carries sound waves, or somewhat as the surface of the water carries the waves produced by the dropping of a pebble.

But now, having assumed the existence of this ether — having assumed it because we cannot conceive of force as traveling without something set in motion to carry it — how much better off are we than before?

What is the constitution of this ether, which we have thus introduced between the earth and the stars?

All matter is assumed by scientists to consist of atoms, or particles, which attract and repel each other. If these atoms attract each other more than they repel, we call the matter a solid. If the attraction and the repulsion are about equal, we call the matter a liquid. If the atoms repel more than they attract, we call the matter a gas. Now, this ether, like all matter, is supposed to be made up of atoms that attract and repel each other; only the atoms of the ether are very much smaller than those in ordinary matter, and very much farther apart.

A necessary part of the ether hypothesis is the supposition that the ether is imponderable — that is, has no weight; for if it had weight, it would fall in the direction of the strongest attracting force, and thus cease to be a uniform medium everywhere present. If it is imponderable, or without weight, we are shut up to the conclusion that the ratio between the interspaces of these atoms and the atoms themselves is vastly greater than the like ratio in ordinary, or ponderable, matter. To put the case plainly: The atoms of the ether, in order to fit the theory, are as small with reference to the spaces between them, as the sun and the earth are as compared with the space between them. And between these atoms there is absolutely vacant space. Therefore we have abandoned the first difficulty of how the force passes from the sun across the interspace to the earth, only to come to a second just like it,— How does the force pass from one atom of the ether to another atom through the vacant space that always exists between them? The illustration

shows what we mean. The large circle represents the sun, the smaller one the earth, and the dots the ether.

Let us ask again the original question, and let the scientist answer. "How is light to pass from sun to earth over ninety-three million miles of vacant space?"

"By means of waves in the ether," says the scientist.

"But hold! Your theory of the constitution of the ether is that it is composed of atoms which are never in contact — which have, like the sun and the earth, vast spaces between them?"

"Yes."

"Then how does this force, in passing through the ether, move from one of these atoms to the other?"

He is silent; he cannot tell.

With our ether hypothesis, we are no better off than we were before. We still have to imagine a body as acting where it is not, and in the absence of anything by which its action may be transferred. The philosophy of the thing is the same whether the exercise of force be on a large or a small scale. In the words of Herbert Spencer: "We see . . . that the exercise of force is altogether unintelligible. We cannot imagine it except through the instrumentality of something having extension; and yet when we have assumed this something, we find that the perplexity is not got rid of, but only postponed. We are obliged to conclude

that matter, whether ponderable or imponderable, and whether aggregated or in its hypothetical units, acts upon matter through absolutely vacant space, and yet this conclusion is positively unthinkable."

Now, as in the days of Job, no man knows by what way the light is distributed. In the springtime, the sunlight touches the earth, and wakes the dormant life beneath the sod, and all the hillsides grow radiant with beauty; but how this light reaches us, no man can tell. And this is not the only mystery.

The world is full of mysteries; but this is because the world is larger than the measure of man's mind. And, too, there are mysteries in God's providence, mysteries in His Word; but they are mysteries because that providence and that Word are larger than our feeble thought. As the heavens are higher than the earth, so are God's ways higher than our ways, and His thoughts than our thoughts. Isaiah 55:9.

Shall we ignore these mysteries, as some so-called scientists do, and say that all the things of nature are explained without the necessity of a Creator? Or shall we allow the mystery to throw about our minds the darkness of doubt and unrest? Or shall we, like Job, find our souls' rest in Him who is greater than all mystery, and confide our all to Him who knows, and who will make known as we are able to endure and understand?

Let us digress from the subject of light long enough to consider this matter of mysteries and our attitude toward them. The mysteries of nature and of providence and of the Word are but examples of the

mysteries that must, in the nature of the case, forever surround the manifestations of God Himself. He is incomprehensible to us, and hence His acts are shrouded in more or less of mystery. But some will say: "If God is incomprehensible, how can we worship Him rationally? Blind worship is possible, but that is superstition; rational worship of an incomprehensible being is impossible."

"On the contrary," says Professor Le Conte, "it is only of such a one that rational worship is possible. In order to worship rationally, we must be able to *apprehend,* but we must not be able to *comprehend.* We must be able to *take hold of,* but we must not be able to *inclose* and determine the limits of the object of our worship. In order to worship him rationally, we must be able to lay hold of and cling to him, even if it be but the lowermost skirts of his outer garment; but we must not be able to embrace, except only his feet.

"We *love* that which is like ourselves and which we can also entirely comprehend; that which is on our own level, or even below us. It is thus we love our friends and our children. We *love and reverence* that which, though like ourselves, is above us, but not beyond our comprehension. It is thus we love and reverence the wise, the great, and the good, among our fellow men. But we *love, reverence,* and *worship* only that which is still like ourselves, but which is not only above us, but in its highest parts incomprehensible to us."—*"Religion and Science," page 102.*

It is not consistent for the skeptic to call his Christian friend unreasonable for believing in some things

that are incapable of a full explanation. So long as the skeptic cannot explain by what means light or gravity travels across the oceans of space, so long as he cannot explain how light from a lamp reaches his eye, he should not complain of his Christian friend for believing some of the experienced but unexplained realities of the higher life.

We believe that gravity reaches across the abyss of space to clasp all worlds in one bond of unity, and we believe that light and heat travel from star to star; but we cannot explain what thus we know is so.

And the Christian believes that a man can be and is born again into a life that transcends mortality, but we cannot understand or explain it all. Like the transfer of light, heat, and gravity, it is covered with more or less of mystery; but nevertheless, it is fact.

CHAPTER VII

The Center of the Universe

ERROR and truth on any particular point cannot reside in the same mind at the same time. Error and truth are opposites; the one is entirely antagonistic to the other. A particular error retained in the mind keeps out of that mind the opposite truth.

In astronomy, for ages, one radical truth was not generally apprehended,—the truth that the earth is not the center of the universe. The idea that the earth was the center, was the great mistake which held men from any large advancement in astronomical science. All their investigations were colored by it; and the entire universe of the visible heavens, tried by it, was woefully out of joint. The whole system of ancient astronomy was built upon a huge mistake.

"Men held, as a fact of absolute, unquestionable certainty, that this earth of ours,—this small whirling globe, less than eight thousand miles in diameter,—was a vast and immeasurable plain, extending to perhaps infinite distances, and firmly fixed upon immovable foundations. They held that around this

great and motionless center moved the other heavenly bodies,—a little sun, a little moon, and a few thousand tiny stars, all placed near, for the sole purpose of lighting and warming our mighty earth.

"The one entirely accepted fact being that our earth was the moveless center of all things, other matters had to fit in with that theory as best they might. The study of the skies was long hopelessly hampered by this one stupendous error. It is singular to glance through records of early astronomical notions, and see the variety of theories that arose, one following another, all designed to explain the things which were seen to happen, all hopelessly wrong because of this one foundation mistake.

"The early Greeks at one time steadfastly believed the sun to be a torch, the stars to be candles, by turns lit and put out. One of their philosophers improved, later, upon the theory, by maintaining that the stars were a kind of meteors, an emanation from the earth,—a sort of 'terrestrial effluvia.'

"Another explanation in vogue among them was that our earth floated in a boundless ocean; and that when the sun vanished at night, he was boated by Vulcan around the north pole, behind certain lofty mountains, which served to hide his radiance, and so he reached the other side in time for next morning's due appearance.

"After a while, it became evident to their minds that this explanation was hardly satisfactory. Then they conjectured that the earth, instead of floating on the waters of an ocean, was built upon enormous pillars,

and that the sun really did go down at night underneath the earth, finding a passage among said pillars, and coming up on the other side."—*"Radiant Suns," pages 15, 16.*

So men clung to the idea that the earth was the center of all things, tried everything by that idea, and endeavored to make everything harmonize with it. But truth cannot be harmonized with error; and, holding error as their foundation, they made painfully slow progress toward the truth.

This world is not the center of the universe. Such a basal truth, I had long believed, must be in the Word, though I could not find it. The Word is a perfect guide for every age and every condition, and so this truth *must* be there. At last, I found it revealed in more than one place. The one most significant to me is Job 26:14. From the rendering in our authorized version, we do not catch the idea at all. There is little wonder at this, however. God spoke the truth in the Hebrew language, and there it was; but when our translators attempted to state the same truth in the English language, they were either unable or afraid to give it the literal rendering. It could not mean just what it said; yet there it was all this time, waiting the mind that could believe it. Knowledge has advanced; men now see that this statement of Holy Writ can be literally true.

I have special reference to the first clause of the verse, which reads, "Lo, these are parts of His ways." Another translation, with a note upon it, is: " 'Lo, these are parts of His ways: and what whisper-word is

heard of Him!' The word rendered 'parts' signifies 'the extremities of lines,' mere points; but I know not of any good English word which I could substitute. The 'whisper-word' is the barest literal rendering, and it is too beautiful to be lost, as in the common version."—*Dr. Pye Smith.*

From this authority, we find that the word rendered "parts" means "the extremities of lines"; that is, "the ends of lines," or "the outlying points." "Lo, these are the outlying points of His works." And in harmony with this idea, we have several other translations of good authority:

"Lo, these are but the *borders* of His works; how faint a whisper we have heard of Him!"—*Noyes's translation.*

"Lo! these are only the *outlying borders* of His works. What a whisper of a word we have heard of Him!"—*Quoted by Henry White Warren, D. D.*

"Lo, these are but the *outskirts* of His ways: and how small a whisper do we hear of Him!"—*Revised Version.*

All these translations help us to catch the load of meaning in the original; and their combined testimony shows that this verse is up with all the astronomical science of the present day—yes, and infinitely ahead of it, daring to assert as a certainty what astronomers merely regard as probable.

And when men have caught glimpses of these sublime truths, and have thought to express their awakened emotions, do you know that the Scriptures alone give them language adequate for their thoughts? It has

taken the almighty power of God to make human words sufficient to express His infinite truths. Says an astronomer of no little note: "However vast the universe now appears, however numerous the worlds which may exist within its boundless range, the language of Scripture, and Scripture alone, is sufficiently comprehensive and sublime to express all the emotions which naturally arise in the mind when contemplating its structure. This shows not only the harmony which subsists between the discoveries of science, but also forms, by itself, a strong presumptive evidence that the records of the Bible are authentic and divine."—*Elijah H. Burritt.*

"Lo, these are but the outskirts of His ways;" and the word "these" refers not alone to the earth, but also to the garnished heavens, mentioned in the verses preceding. Though we study the expanded heavens as we may; gather facts so many as we can; get as large a conception of space as possible; yet, studying and toiling to the extent of our ability, we shall never get beyond this verse. It will never grow old. Human minds will never frame in better words the truth it contains. Human minds will never, either here or hereafter, find all the depths of its meaning. It is an infinite truth.

True, it does not say that the earth is not in the center of the universe. But it tells far more than that; for though it does not say where the *earth is not,* it does define just where the *earth is,— on the outskirts.* If the earth is on the outskirts, it certainly cannot be in the center. And as the garnished heavens that we

see, are also but "the outskirts" of God's works, and as these are but a "faint whisper" of the word that spoke them into existence (Ps. 33:6, 9), then the distance to that center must be immense, wherever that center be.

But why did men think that the earth was the center of the universe? What led them to this conclusion? The apparent motion of the heavenly bodies was probably one great reason why they believed as they did. But there is a certain fitness, after all, in a self-centered man's believing in an earth-centered universe. It is the heathen rendering of, "All things are yours."

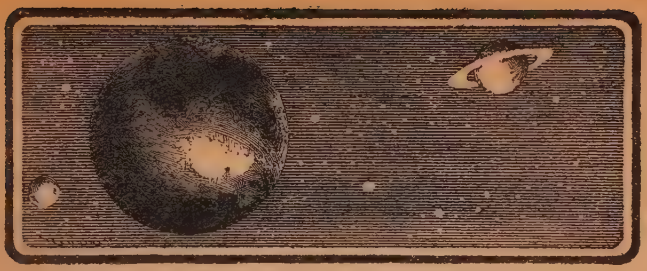
But the self-subdued man is prepared to view all this far differently. To such a man, it seems highly appropriate that this earth should be but a speck, the extremity of a line, in immensity, and that it is not nearly so important in the machinery of the universe as the untamed intellect might believe it to be.

By these two views are we shown that material things are to be seen through the spiritual, being spiritually discerned. We also see that the unregenerate man labors at a tremendous disadvantage in seeking to understand God's works. And thus we realize something of the blessed import of the term "Christian education." Last of all, we are more and more confirmed in our belief that the Word is an all-sufficient guide to man; and, furthermore, that the Word of God and the works of God are indissolubly connected,—the works testifying of the Word, for they are its manifestations; and the Word testifying of the works, for through it they have existence.

NEBULA IN TRIANGULUM

THE ANDROMEDA NEBULA

This is not really a nebula, but a vast cluster of stars. This galaxy of suns is immensely larger than our planetary system.



CHAPTER VIII

The Earth in Space

CLOSELY associated with the old error that the earth was the center of the universe, was another, equally erroneous, and possibly more fatal to advancement in the truth. It was the belief that the earth had a material support. Some supposed the earth to be flat, and afloat on an immense ocean. Others, while they believed that it was flat, declared that it was supported by enormous pillars. What the pillars rested on, all seemed to be perfectly willing to leave to uncertainty. They must have a support for the earth; *they did not care to trace the matter back further than that.*

One advance from this enslaving error was appreciation of the fact that the earth is round. As nearly as we can now tell, there have always been at least a few who have realized that the earth is round; but it was not generally believed. Hundreds of years ago the Word declared the same great truth. There are a number of texts which cannot be explained except in the light of this truth; and in one place, we have

a plain declaration of it: "It is He that sitteth upon the *circle* of the earth." Isa. 40:22. "It is He that sitteth upon the *globe* of the earth."—*Id., Catholic translation of the Latin Vulgate.* "He sitteth upon the *sphere* of the earth."—*Id., Gesenius, quoted by Warren.* For the word "upon," the American Revised Version gives "above." Thus we may have, as a possible rendering of this text, "He [God] sitteth above the circle, sphere, or globe, of the earth."

But while some men could conceive that the earth is round, the idea that it is without visible support was always beyond any of them. To present it to them was to appall them. They could see that such an idea would demolish all their systems of astronomy, and leave them utterly bewildered in the midst of a scientific chaos. Put yourself, if you can, in their place. Get an idea of a solid, stable earth, resting on firm foundations of pillars and rocks, turtle, elephant, or whatever the conjecture. Let all your ideas of astronomy be determined by this. Then try to think of what it would mean to discover suddenly that the earth is rolling in space at the rate of one thousand miles an hour, and shooting onward at the far more rapid, almost frightful speed of over eleven hundred miles *a minute,* with nothing above or below or round about it to give support.

Could a mind at once take in such a truth?—It seems not: error is too enslaving for that. "The very thought of such a restless, whirling globe, where all had been reckoned as absolute fixity, was startling to the imagination until men grew used to it." Rome

was against the new idea; but even Rome had to give way before the truths of astronomy. Men might be led to believe the word of Rome, though it was plainly against the statement of the Word of God; but it was difficult to make them believe the word of Rome where nature uttered a plain denial. The opening truths of astronomy shook Rome to her very foundations. Men were racked and burned; but the truth in its majesty moved on. The Word was beginning to lighten the earth. Those truths were the truths of the Word. God's Word had been a witness all through those dark days, but Rome had sought to impeach its testimony. Then, behold! God called another witness into court. Nature began to thunder forth the truth which proved Rome unreliable. Nature was against the pope, because the pope was against nature; and men would believe nature in preference to the pope.

While Rome racked the bodies of men, truth racked their minds. Thus the contest raged; and the battle still is on. But that truth was the truth of the Word, and that advancing light was the light of God. And so, from the idea of a flat earth set on pillars, men have come to the great truth that the earth is round and hung in space.

For a man to get away from the old idea, to cut loose the earth from all visible support and launch it forth into space, his mind itself had to be cut loose, in a sense, from all visible supports, and swung out into a vast unknown. And it was truth which cut men's minds loose, and set them free. "The truth shall make you free." A mind thus set free from error was like

a ship loosed from its moorings, to sail the broad oceans before it. It was like a bird beginning to mount on its pinions to view more broadly the works of God.

To have such a narrow and mean conception of the works of God as these men had, was to have, unavoidably, a narrow and mean conception of God. God wants every one to have true ideas of His works; for thereby the mind is led to true ideas of God. He has given us revelations, in His Word, concerning these things; but we learn so slowly! Ages ago the Lord asked Job, "Whereupon are the sockets of the earth made to sink?" Job 38:6, margin. And if the same question had been asked the scientists of old, they very probably would have said: "Sockets? The earth has no sockets, much less anything upon which they would be made to sink."

But we know that the question was not utterly lost upon Job. He saw the pertinence of the question, "Whereupon?" He had said previously, "He stretcheth out the north over the *empty* place, and hangeth the earth upon *nothing*." Job 26:7. In this, Job attempted to tell *whereupon* the sockets of the earth were made to sink. He said that the earth hangs on *nothing*. Scientists have got about that far now. They say that the earth hangs on *no thing*, but that it is upheld by a *power*, which they call "gravitation." Job said that God "hangeth the earth." In this, he shows that indeed *power* suspends the earth, and more, that this power is the power of God.

But Job evidently had not yet got the ultimate answer in such a way that he could rest from further

inquiries in that direction; for shortly afterward the Almighty asked Job the ever unanswered question, "Whereupon are the foundations of the earth made to sink?" No matter what man's attainments, that question, like all the others which God asked Job, is forever beyond man's complete answering. We to-day can answer the question no better than could Job. We shall never be able to answer it fully. To answer completely any one of God's questions is to measure Him on that one point. We shall never be able to do that. The ultimate and full answers lie in the inscrutable mind of the Creator Himself. One mystery cleared, countless others, deeper and more baffling, appear. "The rate of scientific progress increases from decade to decade, and yet the new problems increase more rapidly. The divine intellect can never be exhausted by the human."

God wants man to know the truth in regard to all He has done. He has lightened the earth and heaven with His revelations; He has given to men His Spirit; and He has left to them His Word, all flooded with light. God thus reveals truth after truth with a lavish hand. He tells us that the earth is not in the center of the universe, but on the outskirts; that it is not flat, but round; and that it is not supported by things material, but by a power (which men call gravitation, but) which God calls the power of His Word, manifested through Jesus Christ.

These truths are revealed as truths having a bearing upon the souls of men. Everywhere that God has revealed a scientific truth, it is found to have a bearing

upon the eternal destiny of men. All truth is spiritual truth. All truth is of God; and as God is a Spirit, truth is spiritual. God Himself says that His Spirit is the truth. (1 John 5:6.) Then away forever with the idea that there is any truth dissociated from God, and which does not minister to the soul!

There is no truth but the truth of God; and it saves the soul. God has literally filled His world with facts, the manifestation of truth. God scatters the light as the farmer sows the seed,— not a few kernels, not a few rays; He *sows* it. "Light is *sown*." And He scatters the light with the same intention with which the farmer sows the seed; namely, that it may yield increase. "Light is sown *for* the *righteous*." Ps. 97:11.

God grant that we may be among these righteous ones for whom the light is sown. God grant that we may be the "wise," who "understand these things." God grant that we may be the "prudent," who "know them." Hosea 14:9. And God forbid that any of us should be the "wicked," who "do wickedly"; for *"none of the wicked shall understand."* Dan. 12:10.

CHAPTER IX

The Impress of Light

"IT is turned as clay to the seal; and they stand as a garment." Job 38:14. For a long time, I had thought that this verse in some way was meant to teach the rotation of the earth. But when I sat down to a consideration of the scripture, its meaning seemed vague and indefinite. I at length determined to make a careful analysis of its every shade of meaning, and determine what it really does say.

I noticed that the verse asserts that something, specified as "it," is turned. But what is that which is *turned?* I concluded first of all to investigate the word "turned." Shall it be translated, "It is changed," or, "It is rolled"? Does the scripture mean that something is changed from one thing to another, or that it is turned over or around? By some, it is rendered, "It is changed as clay under the seal;" by others, "It is rolled as clay to the seal." Which is preferable? Which is correct?

I find that the original Hebrew word is *haphak.* It is a primitive root, meaning, to turn about or over.

By implication, it may mean, to change, overturn, reform, pervert. I then went to other places in the Word to ascertain its use. A few passages will show how it is employed.

In Hosea 7:8, I read, "Ephraim, he hath mixed himself among the people; Ephraim is a cake not turned." Here we have a familiar scene brought to view. The batter for a griddlecake is spread upon the pan, and there it is left; it is not *turned over*. The word here used, unmistakably means to make at least a half revolution.

In the thirty-seventh chapter of Job,—the chapter preceding the one that contains the verse under consideration,—we have this word used with two adverbs that throw light upon its significance. "He scattereth His bright cloud: and it is turned *round about* by His counsels." Verses 11, 12. Then the words "round" and "about" may follow this word. This shows that it is sometimes used in the sense of *revolve*. In Job 9:5, we have a further illustration. "Which removeth the mountains, and they know not: which *overturneth* them in His anger." Here the word is rendered "overturneth," and the meaning is very manifest.

But we have a still more significant illustration of the meaning of this word. "When Gideon was come, behold, there was a man that told a dream unto his fellow, and said, Behold, I dreamed a dream, and, lo, a cake of barley bread *tumbled* into the host of Midian, and came unto a tent, and smote it that it fell, and *overturned* it, that the tent lay along." Judges 7:13. The words "tumbled" and "overturned" are both from

this Hebrew word *haphak*. The barley loaf *rolled,* or tumbled,—turned over and over,—till it came to a tent; then the tent, being smitten, fell, was *overturned,* and lay along.

Then there is no mistake. This word is often used in the sense of turning over or around. It may mean overturn, or turn over and over. It is translated "tumble." It has in it the idea of rolling or revolving. This is its first and inner meaning. Any other use is by implication, and is therefore secondary; it came as an afterthought. And if you or I were writing in the Hebrew, and wished to use a word to denote the rotation of the earth, I think you will admit that we would use the one employed in Job 38:14.

Then so far as the meaning of the word "turned" in this verse is concerned, we see that it may be used in the sense of revolve. And if the word "it" refers to the earth, this verse declares that the earth is revolved, or turned around or over. But to what does the word "it" refer? What is its antecedent? We must go to the preceding verse to discover.

"It" is a pronoun, and therefore refers to some noun used before. It stands for some *thing* under consideration. Furthermore, "it" is singular, and therefore a plural noun cannot be its antecedent. I find that the twelfth verse begins the discussion; therefore the twelfth or the thirteenth verse must name the thing which in the fourteenth verse is mentioned as being turned.

I find four singular nouns used — four single things mentioned — in these two verses. The "it" must refer

to some one of the four. The things mentioned are morning, dayspring, place, and earth. All the other things mentioned are in the plural number, and would require the pronoun "they" instead of the singular pronoun "it." If we supply these words one after another in the place of "it," we shall have these sentences: The morning is turned as clay to the seal. The dayspring is turned as clay to the seal. His place is turned as clay to the seal. The earth is turned as clay to the seal.

Only one of these sentences will make any sort of sense. The figure is, "as clay to the seal." It is not, "as seal to the clay." Keep the order carefully in mind. The seal is not, as is usually the custom, turned to the clay; the figure is reversed. Why is it reversed? There must be some purpose in employing a figure exactly the opposite of what is usual. If we had here the usual process, something would be turned as a seal is turned upon the clay to make its impression.

What a magnificent illustration this would be to a flat-earth, stationary-earth, revolving-sun theorist! The dayspring, the sun, is turned, as a seal to the clay, to place its impression upon the earth! If the earth is stationary, and the sun rolls around it, and if the Bible is to affirm this, here is a noble chance to do so.

We know that the sun does act upon the earth much as a seal acts upon the clay. Wherever the sunlight rests, the earth responds to its touch as clay responds to the seal. This part of the picture seems very appropriate. But to suit our stationary-earth friends, the

language should be, "It [the sun] is turned as the seal to the clay." But it reads, "as clay to the seal."

Let us supply "earth" in the place of "it," and see what meaning we gather. "It [the earth] is turned as clay to the seal." The earth, by its daily rotation, *is* turned to the sun as clay is turned to the seal. But to state this scientific fact, it was necessary to rearrange the figure, and state it in just the reverse of the usual relation of the seal and the clay, to do which shows careful thought. Consider this. A figure most happy and appropriate is discovered. This is the figure of the clay and the seal. But with clay and seal, the seal, or signet ring, is turned to the clay, while in the case of earth and sun, the reverse is true; that is, the earth, the clay, is turned to the sun, the seal. Therefore, to use the figure and be scientifically exact, it was necessary to reverse the figure. This gives us still all the lesson the figure can give, and it makes the statement scientific; but to one searching into its meaning, it is at first a little puzzling. Yet, understanding it, we must admire its wealth of thought, and the conciseness and clearness of its language.

But what does the rest of the verse mean? To what does that last clause refer,—"and they stand as a garment"?

Turning to the Revised Version, I read, "and *all things* stand forth as a garment."

"And all things stand forth as in rich apparel."—*Noyes's translation.*

"And they stand forth as in gay apparel."—*Translation of the American Bible Union.*

"And everything fashioneth itself as in a garment." —*Translation by Delitzsch.*

"And that everything might appear there with new garments."—*Translation from the French, by Mrs. H. R. Salisbury.*

Do you catch the meaning? The earth is turned as clay to the seal; and in catching its impression as clay receives the impression of the seal, everything grows green and beautiful under the influence of the sunbeams.

"It is God that hath appointed the dayspring to visit the earth (turns the earth to the light), and diffuseth the morning light through the air, which receives it as readily as the clay doth the seal (verse 14), immediately admitting the impression of it, so as of a sudden to be all over enlightened by it, as the seal stamps its image on the wax; and they stand as a garment, or as if they were clothed with a garment. The earth puts on a new face every morning, and dresseth itself, as we do."—*Matthew Henry.*

"It is rolled (turned) as clay to the seal; and (all things) stand forth as in splendid attire."—*Translation by Prof. Homer R. Salisbury.*

" 'It is rolled.' The 'it' refers to the earth, and the verse speaks of the earth shone upon by the morning sun."—*Salisbury.*

I believe that this verse states the relation of the earth and the sun as truthfully as any living man can put it. More than that, it states in few words all that men have decided after years of study. The earth, day by day, even hour by hour, by the rotation on its

axis and by the yearly journey in its orbit, is turned to the sun. And the sun touches the earth with light, and leaves there its impression, even as the seal touches and impresses the clay.

And now, having studied this passage which declares that the relation of earth and sun is that of clay to seal, let us read a few lines from a noted scientist, and see how nearly the same idea is expressed by him, though no one would suppose that this verse from the Bible was in his mind:

"Our world is a halting place where this energy [from the sun] is conditioned. Here the Proteus works his spells; one selfsame essence takes a million shapes and hues, and finally dissolves into its primitive and almost formless form. The sun comes to us as heat; he quits us as heat; and between his entrance and departure the multiform powers of our globe appear. They are all special forms of solar power,—*the molds into which the strength is temporarily poured, in passing from its source through infinitude.*"—*John Tyndall.*

Though these two illustrations are not identical, they are aimed at the same great truth. The Bible speaks of earth's myriad forms as the response of clay to seal; they are the stamp of the sunlight upon the earth. The scientist calls these forms molds into which the sunlight is poured. Doubtless Tyndall himself would admit that the Bible illustration gives far the truer conception. Scientists never grow tired of telling how much we receive from the sun. I quote a few paragraphs from a popular book:

"It is true that from the highest point of view the sun is only one of a multitude,—a single star among millions,—thousands of which probably exceed him in brightness, magnitude, and power. He is only a private in the host of heaven.

"But he alone, among the countless myriads, is near enough to affect terrestrial affairs in any sensible degree; and his influence upon them is such that it is hard to find the word to name it; it is more than mere control and dominance. He does not, like the moon, simply modify and determine more or less important activities upon the surface of the earth, but he is almost absolutely, in a material sense, the prime mover of the whole. To him we can trace directly nearly all the energy involved in all phenomena, mechanical, chemical, or vital. Cut off his rays for even a single month, and the earth would die; all life upon its surface would cease."

"There has always been a more or less distinct recognition of this fact. . . .

"But while the material supremacy of the sun has always been recognized by thoughtful minds, and has even been made the foundation of religious systems, as with the Persians, it has been reserved for more modern times, and to our own century, to show clearly just how, in what sense, and how far the sunbeams are the life of the earth, and the sun himself the symbol and viceregent of the Deity. The two doctrines of the correlation of forces and the conservation of energy, having once been distinctly apprehended and formulated, it has been comparatively easy to conform them

by experiment and observation, and then to trace, one by one, to their solar origin, the different classes of energy which present themselves in terrestrial phenomena — to show, for instance, how the power of waterfalls is only a transformation of the sun's heat; and that the same thing is true, a little more remotely, but just as certainly, of the power of steam, of electricity, and even of animals. The idea is now so familiar that it is hardly necessary to dwell upon it, and yet, for some of our readers at least, it may be worth while to examine it a little more closely.

"Whenever work is done, it is by the undoing of some previous work. When a clock moves, it is the unwinding of a spring or the falling of a weight which keeps it going, and some one must have wound it up to begin with. If the water of a river falls year after year over a cataract, and it is intercepted to drive our mill wheels, the river continues to run because some power is continually raising and returning to the hilltops the water which has flowed into the sea — a process precisely equivalent to the daily rewinding of the clock. If the powder in a rifle explodes and drives out the bullet, its explosive energy depends upon the fact that some power has placed the component molecules in such relation that, when the trigger is pulled, and the exciting spark has, so to speak, cut the bonds which hold them apart, they rush together just as suspended weights would fall if free.

"Before the same substance, which once was a charge of gunpowder, but now is dust and gas, can again do

the same work, the products of the explosion must by some power be decomposed, and the atoms replaced in the same relation as before the firing of the gun; and this process is mechanically analogous to the lifting of fallen weights and placing them upon elevated shelves, or hanging them from hooks, ready to drop again when the occasion may require.

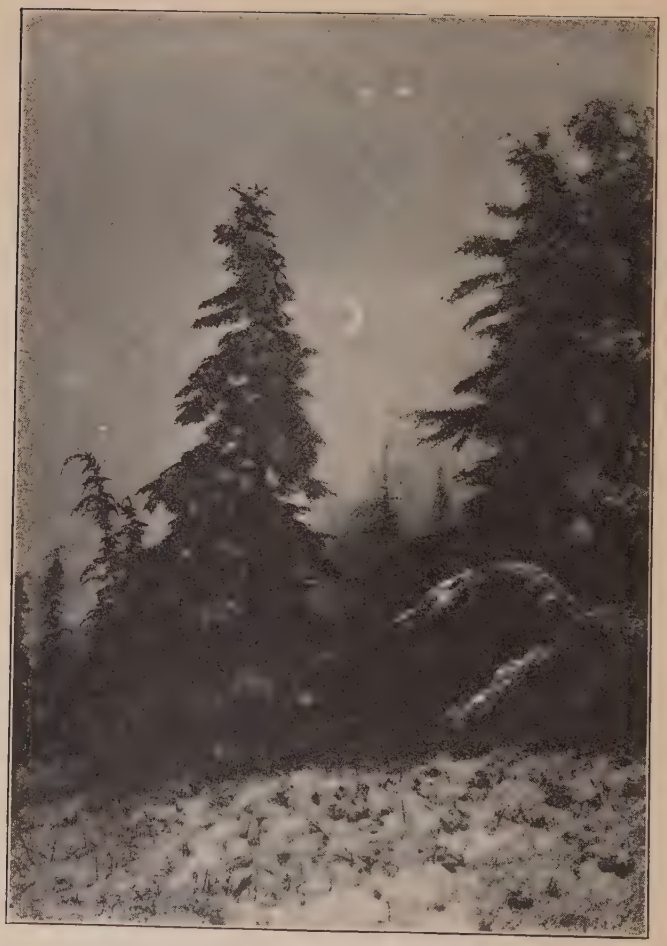
"Precisely the same thing is true of the heat produced by the combustion of ordinary fuel: It is due to the collapse of molecules, for the most part of oxygen on one side, and carbon and hydrogen on the other, which have been separated and built up into structures by the action of some laboring power.

"The same can be said of animal power, for all investigation goes to show that in a mechanical sense the body of an animal is only a very ingenious and effective machine, by means of which the living inhabitant which controls it can utilize the energy derived from the food taken into the stomach. The body, regarded as a mechanism, is only a food engine in which the stomach and lungs stand for the furnace and boiler of a steam engine, the nervous system for the valve gear, and the muscles for the cylinder. *How* the personality within, which wills and acts, is put into relation with this valve gear so as to determine the movements of the body it resides in, is the inscrutable mystery of life; the facts in the case, however, being no less facts because inexplicable.

"And now, when we come to inquire for the source of the energy which lifts the water from the sea to the mountain top, which decomposes the carbonic acid

THE TOTAL ECLIPSE OF THE SUN, JUNE 8, 1918

From the painting by Howard Russell Butler, N. A. The corona and the prominences appear as observed through thin clouds at the U. S. Naval Observatory Station, Baker, Oregon.



THE COLD ATMOSPHERE OF WINTER

of the atmosphere, and plant foods of the soil, and builds up the hydrocarbons and other fuels of animal and vegetable tissue, we find it always mainly in the solar rays. I say mainly, because, of course, the light and heat of the stars, the impact of meteors, and the probable slow contraction of the earth, are all real sources of energy, and contribute their quota. But, as compared with the energy derived from the sun, their total amount is probably something like the ratio of starlight to sunlight; so small that it is quite clear, as we said before, that a month's deprivation of the solar rays would involve the utter destruction of all activity upon the earth."—*"The Sun," Young.*

All this is true enough. But while we keep in mind the influence of the sun, let us not forget the other side of the subject. The sun, it is true, acts with marvelous power upon the earth; but suppose the earth, like the moon, perhaps, did not respond to that influence — what then? While we get a true value of the position and power of the sun, let us not forget that to the earth has been imparted the power to respond to the sun's influence. If this power of responding had not been imparted to the earth, the sun might shine here forever, without effect. But while the sun, like the seal, can give its impression, the earth, like the clay, has the power to respond.

If I should press a seal upon the hard surface of a granite rock, there would be no impress. The granite cannot respond to the seal. But when I place the seal upon the softened, yielding, responsive clay, or wax, I get an exact impression of the seal.

Scientists may well admire the power that the sun exerts; but they should not forget this other great fact,— that the earth is endowed with the ability to respond to the sun's influence. We should have a just conception of the sun as a motive power in the earth; but it need not hide from our minds the fact that the earth has its part to do in making the proper response.

The sun must touch the earth and wake it to its work, energize it in its labors. Without the sun, the earth would remain passive, dead. It is like the lump of passive clay: if it does not receive the stamp of the seal, there will be no image. If the earth is not touched by the sun, it, like the clay, must remain a barren void.

The *response* of the clay has its part in forming the image of the seal. And it is the response of the earth to the sunlight that makes all terrestrial activity possible. The sun must *impress,* but the earth must *respond.* Let us take a few examples.

Suppose there were no air on the globe. The quantity of vapor would almost instantly adjust itself to any variation of temperature. The maximum amount possible would thus always be present at a given place.

"An elevation of temperature would be attended by rapid evaporation, and the amount of water required to fill the space would suddenly flash into vapor; while, on the other hand, a corresponding depression in temperature would be accompanied with an equally sudden precipitation of the excess of water which the air

could no longer contain, not in genial showers or diffuse rain, but in terrific torrents, of which the deluging showers of the tropics can give us only a feeble conception; for the drops falling without resistance, would be as destructive in their effect as volleys of leaden shot."—*Josiah P. Cooke, Erving professor of chemistry and mineralogy in Harvard University.*

Let us take another illustration. A general law of nature is, that all substances are expanded by heat and contracted by cold. Water, except within certain very narrow limits, to be considered shortly, form no exception to the general rule. In fact, but for this expansion, it would be difficult to heat or cool large quantities of liquids.

"All liquids are very poor conductors of heat, and can be heated only by bringing their particles successively in contact with the source of heat. When you set a teakettle over a fire, the first effect of the heat is to expand the particles of water resting on the bottom of the kettle, which, being thus rendered specifically lighter, rise, and are succeeded by colder particles, which are heated and rise in their turn; and thus the circulation is established by which all the particles are successively brought in contact with the heated bottom of the kettle, and in the course of time the temperature of the whole mass is raised to the boiling point.

"The case is similar when you add ice to a pitcher of water in order to cool it. The water at the top of the pitcher, in contact with the ice, is, of course, cooled, and being rendered specifically heavier than the water

below, sinks and gives place to the warmer water, which is cooled and sinks in its turn, and thus, as before, a circulation is established, which continues until the temperature of the whole water is reduced to 40°. But at this point, the circulation is entirely arrested; for in consequence of its singular constitution, water at 39° is lighter than water at 40°, and consequently remains at the top. And so it is as the temperature sinks toward the freezing point. The colder the water, the lighter it becomes, and the more persistently it remains at the surface. Hence, although the upper layers of water may be readily cooled to the freezing point, yet, in consequence of its poor conducting power, the great body of the liquid will remain at the temperature of 40°.

"The cold atmosphere of winter acts upon the ponds and lakes exactly as the ice on the water in the pitcher. They also are cooled from the surface, and a circulation is established by the constant sinking of the chilled water until the temperature falls to 40°. But at this point, still eight degrees above the freezing point, the circulation stops. The surface water, as it cools below this temperature, remains at the top, and in the end freezes; but then comes into play still another provision in the properties of water. Most substances are heavier in their solid than in their liquid state; but ice, on the contrary, is lighter than water, and therefore floats on its surface. Moreover, as ice is a very poor conductor of heat, it serves as a protection to the lake, so that at the depth of a few feet, at most, the

temperature of the water during the winter is never under 40°, although the atmosphere may continue for weeks below zero.

"If water resembled other liquids, and continued to contract with cold to its freezing point,—if this exception had not been made,—the whole order of nature would have been reversed. The circulation just described would continue until the mass of water in the lake had fallen to the freezing point. The ice would then first form at the bottom, and the congelation would continue until the whole lake had been changed into one mass of solid ice. Upon such a mass, the hottest summer would produce but little effect; for the poor conducting power would then prevent its melting, and instead of ponds and lakes, we should have large masses of ice, which during the summer would melt on the surface to a depth of only a few feet.

"It is unnecessary to state that this condition of things would be utterly inconsistent with the existence of aquatic plants or animals, and it would be almost as fatal to organic life everywhere; for not only are all the parts of the creation so indissolubly bound together that, if one member suffers, all the other members suffer with it, but moreover, the soil itself would, to a certain extent, share in the fate of the ponds. The soil is always more or less saturated with water, and, under existing conditions, in our temperate zone, the frost does not penetrate to a sufficient depth to kill the roots and seeds of plants which are buried under it. But were water constituted like other liquids,

the soil would remain frozen to the depth of many feet, and the only effect of the summer's heat would be to melt a few inches at the surface.

"It would be, perhaps, possible to cultivate some hardy annuals in such a climate, but this would be all. Trees and shrubs could not brave the severity of the winter. Thus, then, it appears that the very existence of life in these temperate regions of the earth depends on an apparent exception to a general law of nature, so slight and limited in its extent that it can only be detected by the most refined scientific observation."—*Josiah P. Cooke, Erving professor of chemistry and mineralogy in Harvard University.*

These illustrations are sufficient to show us how things terrestrial are adapted to, and respond to, the sun and its heat. It is true that the heat of combustion, the energy of life, the thunder of the express train, are but sun power working in some other form. This is all wonderful. But that the things of earth are adapted to this energy and are able to employ this sun power is no small part of the wonder.

And in the study of this adaptation of sun to earth, and earth to sun, with all their multiform phenomena, there is science enough for any man, though he lived for untold ages. But the earth is only one planet out of eight, we know; and each planet carries its own wealth of mysteries and wonders. And the sun is only one out of millions in the universe. What a wealth, then, of adaptations of suns and planets, and planets and suns! What interweaving of power and influence, of impression and of response! How marvelous the

structure of the universe! What a field for the human mind! What infinite problems and untold mysteries! What countless truths ever being revealed, yet never fully understood!

"It is turned." The earth is turned by some agency. The words are not, "It turns," but instead, "It is *turned*." This puts the agency, the power, not in the earth, but outside the earth. Therefore that science is wrong which teaches that the earth makes these movements through its own inherent energy. Then by what power is it turned? I answer the question in the words of another:

"It is not by an original power inherent in nature that year by year the earth produces its bounties, and the world keeps its continual *march around the sun. The hand of infinite power* is perpetually at work *guiding this planet.* It is *God's power momentarily exercised* that keeps it in position in its *rotations.* The God of heaven is constantly at work."—*Mrs. E. G. White.*

Science is correct in saying that the earth moves around the sun; it is correct in saying that the earth rotates; but it runs into error when it seeks to show that the earth so moves through inherent energy, and that in this work, it is sufficient unto itself. He that made "the seven stars and Orion" (Amos 5:8), and hung "the earth upon nothing" (Job 26:7), that "meted out heaven with the span, and comprehended the dust of the earth in a measure" (Isa. 40:12), that brings out the host of heaven by number, calling them all by their names, in "the greatness of His might"

(verse 26), He it is who sends the earth upon its destined way.

Ever and ever the earth, as the Word declares, is turned to the sun, as clay to the seal. And ever and ever, like the clay, the earth responds to the touch of the sunlight, "and all things stand forth in splendid apparel." The sun paints the earth with the hues of its light reflected in sky and cloud, in the tinting of the flowers and the verdure of the fields. It stamps the earth with the impress of its light and heat, and vegetation starts forth as at the touch of a magic wand. Energized by its power, and made radiantly glorious in its light, the earth rolls on its destined way, keeping time to "the music of the spheres."

CHAPTER X

Celestial Magnitudes

"LO, these are but the outlying borders of His works; and how small a whisper do we hear of Him! But the thunder of His power who can understand?"—*Job.*

"The planetary system occupies a portion of space nearly six thousand millions of miles across, yet this immense distance seems to be but a mere speck in immensity. Compared with the nebula of Orion alone, which is only a spot in the heavens, it is a mere point; and outside of the planetary system are a multitude of shining orbs, some radiant with splendor, some faintly glimmering with beauty. The smallest telescopic aid suffices to increase their number in an incredible degree, while with the full power of the grand instruments now in use, the scenes presented in the starry heavens become actually so magnificent as to stun the imagination and overwhelm the reason. Worlds and systems and schemes and clusters and universes rise in sublime perspective, fading away in the unfathomable regions of space, until even thought itself fails

in its efforts to plunge across the gulf by which we are separated from those wonderful objects."—*Gen. O. M. Mitchel.*

It is quite impossible to get any proper idea of star distances. Miles are far too small as units in the great computation necessary to express these distances. A larger unit becomes absolutely necessary. Astronomers have therefore employed the light unit, or light year. Light seems almost instantaneous; but so far as our eyes are concerned, it really takes time to travel. Its velocity has been measured many times, by many different persons, and by a number of thoroughly reliable methods; and the results are quite uniform, showing that it travels at a rate of 186,000 miles a second, or a little over 11,000,000 miles a minute. The distance that light would thus travel in a year is obtained by multiplying 16,070,400,000 miles, one day's travel, by 365, or 5,865,696,000,000 miles. This is the light year; it is the unit for measuring distances to the fixed stars. It is to the astronomer what feet are to the carpenter, or what rods are to the surveyor.

The immense distance over which light can move in a year is inconceivable to us. Yet there are stars so far removed from us that it takes their light hundreds of years to reach us. Some of the distances from us to these stars have actually been measured.

"In case a luminous body were to be suddenly called into being, and located in space at the distance of 11,160,000 of miles from the eyes of an observer who was on the lookout for its light, this light would not

reach him until *one minute* after the creation of the object; and should it suddenly be struck from existence, the observer would behold it for one minute after the extinction."

And now just a few words as to the parallax of the fixed stars. "If it were possible to measure on the earth's surface a base line of a thousand miles in length, by locating an observer at each extremity of this base with instruments suitable to fix the moon's place among the fixed stars, the telescopes of these two observers, directed to the moon's center at the same instant, would incline toward each other, and the visual ray from each of these instruments would meet at the moon's center, and form an angle with each other."

This gives a triangle whose angles are marked by the moon at the apex, an observer at each end of the base line. One observer sees the moon from one direction, and the other observer sees it from another direction. That is, to each observer, the moon seems to be in a different spot in the sky. This displacement, or difference in direction, owing to the different position of the eye that views it, is called the parallax.

A very simple experiment will help you to see that a change in the viewpoint will produce an apparent change of position in the object under observation. For example, look toward the wall of one side of your room; hold the index finger of your hand erect in front of you, at some distance from your face, and close the left eye. You will now see that your finger covers a certain spot on the wall, as at A. Do not

move your finger, but open your left eye, and close your right. The finger will seem to change its position to the right, and cover another spot on the wall, as at B. In the language of astronomy, this apparent change in the position of your finger is called its parallax.

The apparent change in the position of the moon is called the lunar parallax, that of the stars is called the stellar parallax.

In the measurement of the triangle before mentioned, the value of the base line is known, being marked by the position of the two observers. By the methods of trigonometry, given the base line and the opposite angles, it is a very simple matter to ascertain the length of either side, which in this case would be the distance from the observer to the moon.

"Parallax, then, in general, is the *apparent* change in the place of an object, occasioned by the *real* change in the place of the spectator."

With the sun, the moon, and the planets, a base line equal to the diameter of the earth, or about eight thousand miles, has sufficed to give a sensible and measurable parallax; but when we attempt by this base line to detect a movement on the part of the stars, we fail utterly. If we view a star with the proper instrument, and measure its position in the heavens, and move eight thousand miles from that spot and make another measurement, we find our *two angles the same*. With a base line only eight thousand miles in length, we can detect no apparent movement on the part of the star; it has no parallax. If the star

were anywhere within 160,000 times the length of our base line, or 1,280,000,000 miles, we should have been able to detect a movement. Therefore the star is more than one billion two hundred and eighty millions of miles away; but how much outside of this, we have no idea until we have made other calculations.

To assist us to understand how small must be the stellar parallax, we have but to consider that the parallax of the moon is 57′; Venus and Mars, 40″; and the sun, only 8.8″.

But can we get no longer base line than this eight thousand miles? We have made one observation on one side of the earth, and another on the opposite side of the earth, and these two points are eight thousand miles apart. Can we find a longer base line? — Yes. We may make an observation at a given date, wait just half a year till the earth has carried us half around her orbit to a spot in space precisely opposite to our first observation, and here we may take a second. Our base line now is a straight line through space, intersected at its center by the sun, and hence measures in length twice the distance from earth to sun, or about one hundred and eighty-five millions of miles. We now have a base line more than twenty-three thousand times as long as before. Surely with such a change in our position, we shall be able to detect an apparent movement of the star.

But even with this immense base line, men sought for years to find the parallax, before they were at length successful. "The efforts to obtain the distance of the stars had been unavailing. . . . A negative solu-

tion had indeed been reached. That their distance was enormous, was made evident from the fact that the parallax had remained insensible, even under the most careful and delicate instrumental tests. Any absolute solution began almost to be despaired of, when hope was again revived by the magnificent refracting telescopes, for which the world was indebted to the skill and genius of the celebrated Fraunhofer, of Munich. This great artist, aided by the profound science of Bessel, contrived and executed an instrument of extraordinary power, and especially adapted to the research for the parallax of the fixed stars.

"Armed with micrometrical apparatus of wonderful precision, and capable of executing measures of great as well as minute distances, the telescope was so arranged as to be carried forward by delicate machinery, with a velocity exactly equal to the diurnal motion of the object under examination. To give some idea of the delicacy of the contrivance with which these telescopes have been provided, it is necessary only to state that the micrometer of the great refractory of the Cincinnati Observatory is capable of dividing an inch into 80,000 equal parts! When mechanical ingenuity failed to construct lines of mathematical minuteness, the spider lent his aid, and it is with fibers of his delicate web that these measures are accomplished. Two parallel threads of a spider's web are adjusted in the focus of the eyepiece of the micrometer, and when the light of a small lamp is thrown upon them, the eye, on looking through the telescope, sees two minute golden wires, straight and beautiful, drawn

across the center of the field of view, and pictured upon the heavens. These are within the control of the observer. He can increase or decrease their distance at pleasure, and so revolve them as to bring them into any position, every motion being accurately measured by properly divided scales.

"Suppose, then, it is desired to take the distance and position of the stars forming a pair. The telescope is directed to them, and they are brought to the center of the field of view. The clockwork is set in action; it takes up the ponderous instrument, weighing more than 2,500 pounds, and with the most astonishing accuracy it bears it onward, keeping its mighty eye fixed on the object under examination. The observer is thus left with both hands free to make his measures. He first revolves his micrometer spider's lines round until one of them shall exactly pass from center to center of the two stars. This position is noted, and from it is deducted the angle framed by this line with the meridian. He then revolves them a quarter of the circumference, and they are perpendicular to their former position. He now separates the wires until the one shall exactly bisect one star, while the other wire passes through the center of the second star, reading this distance on the proper scale. He has fixed, in these two observations, the position and distance of the two components of the double set. Such is the precision attained in this work, that the most minute motions cannot escape detection. If the stars separate from each other at so slow a rate that a million of years would be required to perform

the circuit of the heavens, their motion would be detected in half a year.

"With machinery more delicate even than this, and better adapted to the purpose, and of a kind somewhat different, Bessel once more renewed the research after the unattainable parallax of the fixed stars. His great instrument, called the heliometer, was mounted as early as 1829, but a multitude of causes and some unsuccessful efforts delayed his principal operations up to August, 1837. Three great principles guided him in his selection of 61 in the Swan as the star on which to perform his observations. *First,* it was affected by a very great proper motion, . . . which indicated it to be among the nearest of all the stars. *Second,* its duplex character adapted it especially to the instrument he was about to employ. *Third,* the region occupied by 61 Cygni contains a number of minute stellar points, close to the double star, and presenting admirable fixed points, to which the relative motion of the two components of the star to be measured might be referred.

"With these advantages, and a magnificent instrument, Bessel commenced his observations. He measured the distance from the center of the line joining the two stars, to two of the small stellar points, which served him as points of reference; and this kind of observation was repeated night after night, whenever the stars were visible, from the middle of August, 1837, up to the end of September, 1838. The entire series of observations was then taken and corrected for every possible known error, and in case any ap-

At the Eyepiece of a Large Telescope

A Segment of the Corona of the Sun
From a photograph taken at the Mount Wilson Observatory, in southern California, when the sun was in total eclipse.

preciable change remained, it could only be attributed to parallax.

"After a most careful and elaborate investigation, a variation commenced to show itself, increasing precisely as parallactic variation ought to increase, and diminishing as it ought to diminish. The period of these changes was precisely a year, and in all particulars there was an exact correspondence in kind with the changes which ought to be produced by parallax. But such was their minute character that Bessel hesitated.

"During another year, the observations were repeated. The same results came out and the previous values were confirmed. A third year's observations, yielding precisely the same values, removed all doubt, and the great Königsberg philosopher announced to the world that he had passed the impassable gulf of space, and had measured the distance to the fixed stars! But how shall I convey any adequate idea of this stupendous distance? Millions and millions of miles serve only to confound the mind. Let us employ a different kind of unit.

"Light, as we have seen, travels at a velocity of 11,160,000 miles every minute of time. Hence to reach us from the most remote of all the planets, Neptune, whose distance from the sun is about 2,791,600,000 miles, will require a journey of *slightly over four hours;* but to wing its flight across the interval which separates our sun from 61 Cygni, will require a period not to be reckoned by hours, nor by days, nor months. Nearly ten years of time must roll away before its

flight, flying in every second 186,000 miles, can complete its mighty journey!

"If the mind revolts at this conclusion; if the distance be too great for comprehension; if the scale of the universe thus suggested even staggers the imagination, I can only say that all subsequent observation has confirmed in the most satisfactory manner the accuracy of Bessel's results. This great astronomer first led the way across the mighty gulf which separates us from the fixed stars. The distance once passed, the route has become comparatively easy, and succeeding observers have determined the parallax of a sufficient number of stars to show that their results are entirely trustworthy."—*Gen. O. M. Mitchel.*

The polestar, or north star, one of the most distant measured, is between forty-five and sixty light-years from us; that is, the light from the polestar, speeding at the rate of over eleven millions of miles a minute, occupies from forty-five to sixty years in measuring the distance between the star and us. Yet such enormous distances are as mere points compared with the awful measure of space itself.

Another star, Alpha Centauri, was observed for its parallax in 1842 and in 1851, by two different observers. The first result was 3.6, and the second 3.5, light years. "Observations made to determine whether the star shows any sign of an annual change of place corresponding to the earth's annual orbital motion, were rewarded by the detection of a very appreciable displacement. In fact, owing to the motion of the earth, each year, in a nearly circular orbit 185,000,000 miles

in diameter, the star Alpha Centauri appears to trace out each year a minute oval path on the celestial sphere, the greater axis of the oval being equal in length to about $\frac{1}{900}$ part of the moon's apparent diameter.

"It follows from this that in round numbers the distance of Alpha Centauri from us is about twenty millions of millions of miles. The distance of the earth from the sun shrinks into insignificance beside this enormous gap. Even Neptune, though circling round the sun at a distance thirty times farther than that which separates us from that luminary, is yet relatively so much nearer than Alpha Centauri, that a sun filling the whole orbit of Neptune would appear, as seen from that star, but about $\frac{1}{900}$ as large as the sun appears to us."— *Richard Proctor.*

Do not miss this. Let us put it in another way: If the sun were so large that it reached out on all sides as far as to the orbit of Neptune,— in other words, if it were a blazing sun 5,583 millions of miles in diameter,— seen from Alpha Centauri, it would appear but $\frac{1}{900}$ as large as the sun appears to us; it would seem like a mere point of light in space.

Viewed at such stupendous distances as only astronomy comprehends, systems and universes seem to dwindle to mere pin points when related to some distant parts. "It is found by the most eminent astronomers of the age, and the most perfect instruments ever made, that the parallax of the nearest stars does not exceed the four-thousandth part of a degree, or a single second." Alpha Centauri is the nearest, having a parallax of .9 of a second, "so that, if the whole great

orbit of the earth were lighted up into a globe of fire 600 millions of miles in circumference, it would be seen by the nearest star only as a twinkling atom; and to an observer placed at this distance, our sun, with its whole retinue of planetary worlds, would occupy a space scarcely exceeding the thickness of a fiber of a spider's web."—*Burritt.*

Thus whole systems, as that of our sun, "dwindle to mere pin points" as viewed from some distant fixed star. This is what astronomy says; but the Word of God goes further, for it mentions all the visible stars of heaven, and asserts that *these,* all that are within our view, are but the extremities of the lines of His works — that is, mere points, as seen from the immense distances of His universe. Not merely that the whole space included within the orbit of Neptune is a mere extremity of a line as seen from some distant confine of space, but that all the visible heavens are but mere points when compared with the rest of God's works. And all this was stated as long ago as the days of Job. In spite of the gigantic strides of modern astronomy, the old Bible is still ahead, and so far ahead that science may well despair of ever overtaking it.

Getting some idea of the import of parallax, we are better able to understand James 1:17. These considerations impart a force and sublimity to the expression of the apostle, which no power of words could improve. In the passage, it is stated literally that with God there "is no parallax nor shadow of turning." "As if the apostle had said, peradventure, that in traveling millions and millions of miles through the re-

gions of immensity, there may be a sensible parallax to some of the fixed stars; yet as to the Father of lights, view Him from whatever point . . . we may, He is without parallax or shadow of change."

Thus does inspiration anticipate the discoveries of science, by seizing upon the very words of science and giving them a meaning that will ever grow grander and more sublime as our knowledge advances toward the true conception. What a magnificent picture of the immutability of God! It will require all eternity to fathom the meaning of this one passage (James 1: 17), for all the universe is employed to illustrate its significance. Thus does God pack an eternity of meaning into His words, and load a whole universe of science into the infinite truths of the Scriptures. Therein has He revealed His eternal purpose. This is a textbook that can never grow old, a science that can never be exhausted.

But how much of an idea have we even now of the immensity of the universe? All our efforts to understand the tremendous distances only confuse and astonish the mind. But though this is so, let us make one more attempt to get a view of space. Let us take an imaginary journey to some of the visible stars.

"If it were possible, to-night, to wing our flight to any one of the bright stars which blaze around us, sweeping away from our own system until planet after planet fades in the distance, and finally the sun itself shrinks into a mere star, we might alight on a strange world that circles around a new and magnificent sun, which has grown and expanded in our sight until it

blazes with a magnificence equal to that of our own. Here we pause, and look out upon the starry heavens which surround us.

"We have passed over sixty millions of millions of miles. We have reached a new system of worlds, revolving about another sun; and from this remote point, we have a right to expect a new heaven, as well as a new earth on which we stand. But no; lift up your eyes, and lo! the old familiar constellations are all there. Yonder blazes Orion, with its rich and gorgeous belt; there comes Arcturus, and yonder the Northern Bear circles his ceaseless journey round the pole. All is unchanged, and the mighty distance over which we have passed is but the thousandth part of the entire diameter of this grand cluster of suns and systems, the Milky Way. Although we have swept from our sun to one of the nearest fixed stars, 61 Cygni, and have traveled a distance which light itself cannot traverse in less than ten years, the change wrought by this mighty journey, in the appearance of the heavens, is no greater than would be produced in the relative positions of the persons composing this audience to a person near its center, who should change his seat with his immediate neighbor.

"Such, then, is the scale on which the starry heavens are built. If, in examining the magnificent orbits of the remoter planets, and in tracing the interminable career of some of the far-sweeping comets, we feared that there might not be room for the accomplishment of their vast orbits, our fears are now at an end." There is infinite room.

"It has been considered probable, from recondite investigations, that the average distance of a star of the first magnitude from the earth is nine hundred and eighty-six thousand radii of our annual orbit, or nine hundred and eighty-six thousand times ninety-two million miles, a distance which light would require fifteen and a half years to traverse; and further, that the average distance of the sixth magnitude (the smallest distinctly seen without a telescope) is seven million six hundred thousand times the same unit, to traverse which, light, with its prodigious velocity, would occupy more than one hundred and twenty years. If, then, the distances of the majority of the stars visible to the naked eye are so enormously great, how are we to estimate our distance from those minute points of light discernible only in the powerful telescopes?"— *Hind's "Astronomy," quoted in "The International Cyclopedia."*

Thus do the starry systems about us seem to be but suburbs of a vast creation. Whichever way we may turn our eyes, and no matter how powerful we make our sight, there is always something shining beyond our farthest reaches into the unending universe of God. Job was right; and with him we cry, "Lo, these are but the extremities of the lines of His works; and how little a whisper do we hear of Him! But the thunder of His power who can understand?"

"God called up from dreams a man into the vestibule of heaven, saying, 'Come thou hither, and see the glory of My house.' And to the servants that stood around His throne He said, 'Take him, and undress

him from his robes of flesh; cleanse his vision, and put a new breath into his nostrils: only touch not with any change his human heart,— the heart that weeps and trembles.' It was done: and with a mighty angel for his guide, the man stood ready for his infinite voyage; and from the terraces of heaven, without sound of farewell, at once they wheeled into endless space.

"Sometimes with the solemn flight of angel wing they fled through Zaarahs of darkness, through wildernesses of death that divided the worlds of life. . . . Then, from a distance that is counted only in heaven, light dawned for a time through a sleepy film; by unutterable space the light swept to them, they by unutterable space to the light. In a moment, the rushing of planets was upon them; and in a moment, the blazing of suns was around them.

"Then came eternities of twilight, that revealed, but were not revealed. On the right hand and on the left towered mighty constellations . . . that seemed ghostly from infinitude. Without measure were the architraves, past numbers were the archways, beyond memory the gates. Within were stars that scaled the eternities below; above was below, below was above, to the man stripped of gravitating body. Depth was swallowed up in height insurmountable; height was swallowed up in depth unfathomable. Suddenly as thus they tilted over abysmal worlds,— a mighty cry arose,— that systems more mysterious, that worlds more billowy, other heights and other depths, were coming, were nearing, were at hand.

"Then the man sighed, and stopped, shuddered, and wept. His overladen heart uttered itself in tears, and he said: 'Angel, I will go no farther; for the spirit of man acheth with this infinity. Insufferable is the glory of God. Let me lie down in the grave, and hide me from the persecution of the infinite; for end, I see, there is none.' And from the listening stars that shone around issued a choral voice: 'The man speaks truly: end there is none that ever yet we heard of.' 'End is there none?' the angel solemnly demanded; 'is there no end? And this is the sorrow that kills you?' But no voice answered, that he might answer himself. Then the angel threw up his glorious hands to the heavens of heavens, saying: 'End there is none to the universe of God. Lo, also, there is no beginning!' "—*Richter.*

CHAPTER XI

The Infinitude of Space

IT is impossible for the human mind to put any limit to space. We run out into the unfathomable abyss as far as imagination will carry us, and when we have reached the utmost limit, and imagination carries us no farther, we cannot say to ourselves, "Here is the end;" for immediately the only barrier we can conceive is something like a huge wall, and beyond this exists still untraced and immeasurable space. We can imagine as much beyond our limit as exists this side of that limit; and we can call this distance a unit, and multiply it by any factor that we are pleased to choose,— a thousand, a million, or a billion,— and still we can think of as much space beyond as that which we have covered by our multiplication.

Mathematically the human mind can find no limit to space. From this fact of mind, many argue that there can be no limit to space,— that it extends out beyond forever, like eternity. But when we come to this decision, the mind is struck with the awful disclosure,— space without any limitation whatever! The

mind grows dizzy with the thought; the heart is dumb with awe. Can it be so? Is there no limit to space?

We will suppose it is evening. Look yonder at the Milky Way. "A band, or irregular stream, of soft light is perceived, with stars at intervals dotting its surface. We get an opera glass, and look through it. Behold, many more stars are visible, with the band of light still beyond. We get a small telescope, and look through that. Very many stars may be counted; and still the band of soft light shines beyond. We go to an observatory, where a large telescope may be found; and through its great tube, countless stars gleam forth, hundreds and thousands of them, where first, with the naked eye, we saw only a few twinkling specks; yet, still the band of light shines on beyond, unchanged. Lastly, we go to America, and observe the Milky Way with the most powerful telescope yet made. A wondrous company of innumerable stars glitter; yet, still, beyond and behind, we have, as ever, the dim, soft light, not even now done away, not even now resolved wholly into stars."—*Agnes Giberne.*

Can we ever get to the end of it—this vast universe? Can we ever be able, no matter what our powers, to say, "This is the limit; we have seen everything in this direction"? Is there no limit to space? Have we no certain answer to this question?

"Suppose that one of the highest order of intelligences is endowed with a power of rapid motion superior to that of light (186,000 miles a second), and with a corresponding degree of intellectual energy; that he has been flying without intermission for six

thousand years, and will continue the same rapid course for a thousand million years to come. It is highly probable, if not absolutely certain, that, at the end of his vast tour, he would have advanced no farther than the 'suburbs of creation,' and that all the magnificent systems of material and intellectual beings he had surveyed during his rapid flight, and for such a length of ages, bear no more proportion to the whole empire of Omnipotence than the smallest grain of sand does to all the particles of matter contained in the ten thousand worlds.

"Were a seraph, in prosecuting the tour of creation in the manner now stated, ever to arrive at a limit beyond which no further displays of divinity could be perceived, the thought would overwhelm his faculties with unutterable emotions; he would feel that he had now, in some measure, comprehended all the plans and operations of Omnipotence, and that no further manifestations of the divine glory remained to be explored. But we may rest assured that this can never happen in the case of any created intelligence."

And now the brain, lost in the frightful sweep of its thought, fairly swims in its efforts to comprehend the infinite. But is this all true? — It seems true; it seems reasonable, and almost certain. But in answer to this question, have we naught but speculations, and reasonings, and *almost* certain probabilities? Is there no word from God? — Yes. Wondering and questioning, I turn to His Word, and read: "Thus saith the Lord; *If heaven above can be measured,* . . . I will also cast off all the seed of Israel for all that they have

done, saith the Lord." Jer. 31:37. Ah, my soul, that Word must be sure! "Saith the Lord" comes as the introduction, and "saith the Lord" follows as the close. "Thus *saith the Lord;* If heaven above can be measured, . . . I will also cast off all the seed of Israel for all that they have done, *saith the Lord.*" "Saith the Lord" and "saith the Lord"—surely this must be true!

And what is it that the Lord says?—He says that if heaven above can be measured,—not if you or somebody else can measure it, but if it can be measured, no matter how,—He will give Israel up, and thereby acknowledge that He has failed. If even His works can be measured by His creatures, then He acknowledges that He will no longer appear before them as God. It will go on record that God has failed. But blessed be His name, He cannot fail. He "never faileth." 1 Cor. 13:8. "*He shall not fail* nor be discouraged." Isa. 42:4. "Thus saith God the Lord, He that created the heavens, and stretched them out; . . . I the Lord have called thee in righteousness, and will hold thine hand, and *will keep thee.* . . . I am the Lord: that is My name: and *My glory will I not give to another.*" Isa. 42:5-8. Israel will not be cast off, and therefore the heavens cannot be measured. One is as sure as the other, and each is as sure as God is true.

Space is immeasurable, and God has taken this fact as the everlasting foundation of one of His promises. Thus does He link His Word and His works. And when you think of the awful infinitude of space, will

it help you to realize the surety of His covenant? As you look out yonder into the abyss that reaches onward to the stars,— yea, that stretches into an expanse as measureless as eternity,— will your soul rise to the thought that thus there is no limit to all that He will do for your soul? God help us all to realize that forever and ever we shall be unable to see all that there is to see of His goodness, and of "the exceeding riches of His grace in His kindness toward us through Christ Jesus," even as we see, and ever as we see, that there is no limit to the infinite fullness of His works.

May God's promises be to us all this. And filled with thoughts of the majestic and stupendous power that upholds the soul that trusts in God, like Jeremiah when the truth was first revealed to him, may we say: "Ah Lord God! behold, Thou hast made the heaven and the earth by Thy great power and stretched out arm, and there is nothing too hard for Thee." Jer. 32: 17.

CHAPTER XII

As the Moon

WHENEVER you consult an almanac to know when there will be a full moon, or to know when the moon will rise or when it will set, and when you consult a table of the tides to learn the time of the high or the low tide, you are in that studying, though it may be unconsciously, a commentary on one of the verses in the Bible. You are simply showing your practical reliance upon a great fact, and that is the faithfulness of the moon. "Once have I sworn by My holiness that I will not lie unto David. His seed shall endure forever. . . . It shall be established forever as the moon, and as a faithful witness in heaven." Ps. 89:35-37.

The moon is a faithful witness in the heavens. Through the ages, it has kept its appointed place, followed its destined path, and never disappointed humanity. Our astronomers have mapped its orbit, have outlined its course years ahead; they tell us when it will be new, when it will wax old, just how long it will be in each quarter, just what part of the heavens it

will occupy; and this is possible because it keeps its way steadfastly, faithfully, never erratic, never whimsical, never doing anything unexpected or unannounced. It is a faithful witness in heaven.

This faithfulness is not due merely to the perfection of the machinery of the solar system. It is rather a reflection of the perfection and faithfulness of Him who ordained it. God is the cause of the uniformity of nature. He it is who has made the universe what it is, and given us its stability, perfection, and endurance.

David speaks of the moon in words like these: "When I consider Thy heavens, the work of Thy fingers, the moon and the stars, which Thou hast ordained; what is man, that Thou art mindful of him? and the son of man, that Thou visitest him?" Ps. 8:3, 4.

This question is asked, not by one who believed what the heathen believed,—that the earth was set in the center of a crystal globe, and that out not so very far away there were lights which were lighted at night and extinguished in the morning,—a child's picture of the universe. No, indeed!

These are words spoken by one inspired by the Spirit of God, that Spirit which searches all things, even "the deep things of God." It reveals a knowledge of the universe which modern astronomy has not begun to approach. When a person grasps some of the revelations of modern science, when he views the skies with the mightiest of our modern telescopes, when he sweeps the heavens with all the power that

The Moon in the Eighteen-Day Phase

HALLEY'S COMET, AS SEEN IN THE EARLY MORNING

Named from Halley, who first ascertained its return around the sun in a period of about seventy-five years. It appeared last in 1910.

modern science has placed at the command of the eye and mind of man, what language can adequately express the feelings that enrapture him? Where alone can man turn for words suitable to voice his emotions when the sights of the skies thrill the imagination, stir the conscience, and awaken the heart? Only the language of inspiration can cover all the range of the feelings; only the words of Scripture can flux the thoughts, and make them flow unimpeded, absolutely free, through the great channels of the soul.

It is at such times that one turns with gladness, with rapture, to quote the words given by inspiration of God. It is then that the devout astronomer exclaims, "When I consider Thy heavens, the work of Thy fingers, the moon and the stars, which Thou hast ordained; what is man, that Thou art mindful of him? and the son of man, that Thou visitest him?"

This is true because every word of God is pure, and unlimited in the fullness of its meaning. When God's Word speaks in facts of nature, it does not glimpse just a few of the facts, as would be the case if dependent upon a partial knowledge; but the Spirit of God, when it mentions the great things of God, has in full view every fact of God's universe that is involved in the statement, and it speaks in language large enough, grand enough, that no future discoveries or ages of study can possibly make it in any sense out of date.

Before men swept the heavens with gigantic telescopes, the Spirit of God read everything in all the vast ocean of the universe. Telescopes will never peer beyond its unmeasured scrutiny. Eye of man will

never behold anything not comprehended by its unlimited knowledge. The mind of man will never grasp anything but that which the Spirit of God has already searched out and given for the benefit of man in its inspired lessons.

Sometimes the intellect divorced from faith views these stupendous spectacles in the heavens to point the soul only to despair; but not so the Word. Agnosticism and philosophical speculations and scientific sophistry would read but a portion of this scripture. It would change it to something like this: "When I consider the heavens, the incomprehensible work of the universe, the moon and stars in their vastness, what is man?" The whole import of the question is then to overwhelm man with his insignificance, and make him feel that he is merely a bubble of foam on the great tossing waves of immensity. As Daniel Webster once said, "Philosophical objections have sometimes shaken my mind with regard to Christianity, especially the objection drawn from the magnitude of the universe contrasted with the littleness of this planet." And the argument becomes more striking, the feelings are affected more intensely, when we contrast all this might not merely with the planet, but with each one of us as a puny individual; but faith arises and faces the difficulty.

The quotation from Daniel Webster is not complete. He continued, "But my heart has always assured me and reassured me that the gospel of Jesus Christ is a divine reality." And he began his statement with the words, "Lord, I believe; help Thou mine unbelief."

These words he left to be inscribed on his sepulcher, and they are chiseled in the marble that rests over his dust at Marshfield. Worthy faith!

The Scriptures would call our attention to the greatness of God's universe, and therefore to the might of the God of the universe, but not to discourage or to awaken distrust. The scripture reads: "When I consider Thy heavens, the work of Thy fingers, the moon and the stars, which Thou hast ordained; what is man, that *Thou art mindful of him?* and the son of man, that *Thou visitest him?* For Thou hast made him a little lower than the angels, and hast crowned him with glory and honor."

This was true of man when created; and though by sin he has lost it for himself, through Christ it is still true for men. In Christ, God still makes him a little lower than the angels; and in Christ, God still clothes him with glory and honor. And this is the great result of a proper study of astronomy. When rightly we consider the heavens, the work of God's fingers, the moon and the stars, which He has ordained, it does not arouse any distrust; it merely causes us to realize the love of God, that He should remember anything so small as a human being. It magnifies the love of God, but does not throw any discredit upon Him. It wonders at the condescension of God as it says, "What is man," that God should do this? It cries out in faith, "Behold, what manner of love the Father hath bestowed upon us."

What the stars alone, what the moon itself, could not tell, the gospel of the Son of God does tell. And

if we have been awed by the might of God displayed in His vast universe, we are awed by the depth of His love displayed in the blessed gospel of His Son; for we know that He who is so great that He has stretched out the universe as you and I would pitch a tent, nevertheless "so loved the world, that He gave His only-begotten Son, that whosoever believeth in Him should not perish, but have everlasting life."

As we look at the skies,—at the stars in their appointed course, at all the celestial bodies keeping their mighty orbits, the spheres rotating in the vast deeps of the creation,—we cannot dispute the *might* of God; and when we view the cross of Christ, the wonderful condescension of the Father in giving His Son, we cannot dispute the immeasurable *love* of God.

CHAPTER XIII

Stars Innumerable

AGES ago the Word declared the stars of the heavens to be innumerable. Years have come and gone; man's knowledge of the skies has been augmented; research through times and seasons has added its stores of facts to the science of astronomy. To-day we say still, the stars are innumerable.

In Abraham's day, even as now and always, the eye could count all the stars seen in the skies. If it were a mere human task God called Abraham to undertake, he could soon accomplish it. It would not be difficult to count all the stars visible even in his fine climate. With a little skill and perseverance, he could soon know the number in sight.

But it was the Creator of the universe who called Abraham forth, and thus he saw by the more than telescope of God's enabling. He could look deeper than any others of the sky gazers of his time. He could fathom the universe spread out to his sight. To Christ were shown the kingdoms of the world and the glory of them, even by the ability of a fallen angel.

John saw beyond the crash of earthly empires to the kingdom of God. And Abraham saw to the deeps of the material universe.

It is therefore clear enough that if Abraham could have counted all the stars to which God called his attention, and they were but what one would ordinarily see, say about fifteen hundred, then this whole passage in Genesis from the life record of Abraham is a piece of nonsense, and presents a stupendous farce. God speaks as though the task were impossible: "*Tell* the stars, *if* thou be able to number them." If Abraham had found himself able to number them, we are quite sure that he would have obeyed God, and told the number of the stars. But Abraham was silent, awed by the sight. The task was beyond him.

According to the modern skeptic, who views it only from the merely human standpoint, it was an easy task; "there were but fifteen hundred." Think of the all-wise Creator of the universe calling Abraham out to look at fifteen hundred stars, and saying, "Tell the stars, if thou be able to number them."

But as Abraham beheld the countless shining orbs of heaven, now first made visible to him as seen from the Creator's viewpoint, God broke upon the awful silence with the revelation of another great fact: "So shall thy seed be." If Abraham saw the stars as they really were, what an overwhelming fact it was: "So shall thy seed be." Surely it must draw upon the faith of even Abraham; but we read that Abraham "believed in the Lord; and He [God] counted it to him for righteousness." But as the modern critic would have

it, all this was done to reveal to Abraham that he was to have fifteen hundred descendants! There were wandering nomads in those days with a larger posterity than that. Thus does the too wise man charge God and His Word with folly. Here is an occasion where we may well say, "Let God be true, but every man [who disputes Him] a liar."

God did not say that there is no number to the stars of heaven; but He appeals to man's inability to count them. God "telleth the number of the stars." Yes, He even "calleth them all by their names." Ps. 147: 4; Isa. 40:26. Likewise God did not say that Israel should be of the precise number of the stars or the number of the dust of the earth. True, He said, "I will make thy seed as the dust of the earth." But in what respect were they to be made as the dust of the earth?—"So that if a *man can number* the dust of the earth, then shall thy seed also be numbered." Abraham's seed were not to be of the precise number of the dust of the earth, but "as the dust of the earth," and "as the sand of the seashore," for the reason that they would be beyond human computation. So God said concerning the stars: "Look now toward heaven, and tell the stars, if thou be able to *number them: . . . so* [beyond human computation] shall thy seed be." Surely God meant what He said, and Abraham did well to believe; for John caught a view of that same company, "a great multitude, which *no man could number.*" Rev. 7:9.

In this text of Genesis just as it reads, with no allowance or modification, we find revealed a truth of

astronomy which is far beyond human ideas or human conception, and that modern astronomy itself is only beginning to appreciate. I believe God has held that truth before man ever since man took his place upon this earth; and nearly four thousand years ago He gave it to Abraham and his seed, coupled with the great truth of those who should be saved.

"Of the number and economy of the stars which compose this group [the Milky Way], we have very little exact knowledge. Herschel informs us that, with his best glasses, he saw and counted five hundred and eighty-eight stars in a single spot, without moving his telescope; and as the gradual motion of the earth carried these out of view, and introduced others successively in their places, while he kept his telescope steadily fixed to one point, there passed over his field of vision *one hundred and sixteen thousand stars;* and at another time, in forty-one minutes, no less than *two hundred and fifty-eight thousand.* At other observations, when examining a section of the Milky Way, apparently not more than one yard in breadth and six in length, he discovered *fifty thousand* stars large enough to be distinctly counted; and he suspected twice as many more, which, for want of sufficient light in his telescope, he saw only now and then."—*"Geography of the Heavens," page 142.*

Let us in imagination visit some large observatory.

"We enter the building, lantern in hand, and rolling open a large segment of the dome, stand beside the telescope under the starry sky. Looking up at the glorious spectacle of the midnight heavens, we recall

the fact that from two thousand to two thousand five hundred stars are visible in the northern hemisphere to the naked eye. . . .

"But the stars which are thus visible form only a small part of those whose existence is known to us. On that table there lies a binocular glass. Take it up and look at any part of the heavens through it, and see what a multitude of stars it brings into view utterly invisible to the naked eye! The binocular forms an admirable and inexpensive instrument for elementary astronomical research, especially when used with maps of the starry heavens. Proctor's star atlas is one of the simplest and best for this purpose, showing, without crowding, all the stars in the British Association catalogue down to the sixth magnitude.

"As we turn over the twelve maps of this atlas, we note the fact that they exhibit 2,487 and 3,466 stars in the northern and southern hemispheres, 5,953 in all, and that the British Association catalogue from which they are taken, professes to include all the stars visible to the naked eye.

"But now turning to a more extensive catalogue, we take down a volume of 1,200 pages — Lalande's catalogue of stars — which gives the right ascension and north polar distances of 47,390 stars, or nearly 48,000 stars; and as the heavens are divided by astronomers into twenty-four parts, corresponding with the twenty-four hours of the day and night, each of the hour sections would contain on an average 2,000 of these stars, or about as many as are ordinarily seen in the entire hemisphere by the naked eye. But what are even

48,000 stars compared with the number which can be seen with a small telescope of three inches aperture? Look at the stars on this chart of the northern hemisphere representing those seen by Argelander and his assistants during their persevering survey of the northern heavens with a 2¾-inch telescope. There are no less than 324,198 stars marked on that chart! They lie almost as crowded together as the sands upon the seashore; and in parts, especially along the Milky Way, the crowding is frequently so great as to make it impossible to distinguish star from star! That chart is a photograph made by Proctor from Argelander's maps. Turning the light of the lantern full upon it, you may observe that some hand has written with pen and ink below its marvelous picture of the star-filled hemisphere the sublime yet simple and touching words of Jesus Christ, 'In My Father's house are many mansions.'

"But now let us use the larger instrument to scan some of the wonders of the heavens. Let us direct it first to the constellation Perseus; and as we have to find a particular spot in the constellation, we set the equatorial telescope by means of its hour circle to 2 hr. 11 m. right ascension, and elevate it to 56 38 north declination, and having rotated it so that the hour on the meridian corresponds with that shown at the moment by the sidereal clock, we mount the steps of the ladder and look through the instrument. A brilliant mass of stars, apparently countless in number, now fills the field of view! That is the magnificent cluster of stars in the sword handle of Perseus. After

gazing for a time at this sublime celestial spectacle, on slightly moving the direction of the instrument, a second glorious cluster comes into view, also of stars from the seventh to the fifteenth magnitudes; and all these stars are, as separate objects, invisible to the naked eye.

"We might spend the whole night in thus examining star clusters, and would only then have begun their survey. But let us glance for a moment at one of the many clusters remarkable for spherical form and compactness. Directing the telescope to 16 hr. 37 m. right ascension and 36° 39 north declination, a wondrous ball of stars blazes up in the center of the field of view. That mighty system is known to astronomers by the modest name of 13 M. Herculis, indicating that it is the thirteenth in Messier's catalogue of nebulæ, and is situated in the constellation Hercules. It was discovered by Halley in 1714, and examined by Messier with a four-foot Newtonian instrument fifty years later, who was able to resolve it into separate stars. With this large equatorial it is perfectly resolved even with low power eyepiece, while with the eyepieces of higher power it seems to blaze and break into separate stars and star branches streaming out from a dense core of glittering light points. Language utterly fails to adequately describe such an object. It has been truly said that none could behold it for the first time without uttering a 'shout of wonder.' And yet that system of worlds is only one among thousands, and has not even a name assigned to it, being only known among astronomers by its number, 13 M. Herculis!

"And now, changing again the direction of the telescope, we bring it to bear on the Milky Way, that faint, mysterious river of light, which streams all across the midnight sky. Pointing the telescope to the edge of the Milky Way, and moving it slowly across its breadth, and then in the direction of its length, we see that it really consists of millions of minute stars closely crowded together, along with larger stars and star clusters. And the Milky Way thus traversing the sky goes completely round the world, crossing the southern hemisphere, and returning again to the northern, in a vast ring-like form, made up of closely compacted stars and star clusters all the way.

"We have spoken of star catalogues and star maps representing thousands of stars, but here are millions! It has been reckoned that the highest telescopic power brings into view no less than fifty or sixty millions of stars, and photography has of late enormously increased the number known to exist by revealing multitudes of stars too faint to be detected even by the most powerful telescope."—*"Creation Centered in Christ," pages 409-412.*

"Wider and wider fields are ever opening before the human gaze. Vaster and vaster universe depths are ever sought into. And still, boundless fields beyond, unfathomable depths below, reward the utmost efforts of which man is capable. Many different computations have been made from time to time, as to the probable number of the stars, bright and dim, which may lie within the grasp of the most powerful

telescope yet made. The sum of some sixty or seventy million seems at present to be a moderate reckoning."

"There are stars in the sky so distant that the most huge object glass ever constructed cannot catch enough of their feeble glimmer to impress their image in the human eye. No man has ever seen those stars from this world; perhaps no man, looking from this world, will ever see a great many of them. And yet those very stars are known to astronomers; and the position of many of them is marked on the celestial map. You do not need to ask how this can be. You already know that the weak shining, which cannot make itself felt by the retina of a man's eye, *can* slowly impress its image on the photographic plate. Hundreds of stars, thousands of stars, utterly invisible to man, have had their photographs taken as truly as you have had your photograph taken, only it has been a longer business."

"If the stars which are known, and which can be known, through photography alone, are added to the list of those known through the telescope, the numbers again rise fast. According to one supposition, the total of one hundred million may be fairly given; according to another, two hundred million may be well within the mark. And even this vast mass may still be, for aught that we know to the contrary, as a mere corner of the universe."—*"Radiant Suns."*

Magnificent glasses now scan the heavens. The photographic plate nightly is turned to the sky to receive its silent record. But as night follows night, and the record grows more complete, the witness grows also more emphatic, and the declaration is forced from

the startled intelligence of man, The stars of the heavens are *innumerable.*

With the most gigantic telescopes, man cannot number all the stars. With the aid of the most exquisitely sensitive photographic plates, man cannot get the autograph of all the orbs shining in the stellar depths. The stars are to us *innumerable.*

God formed the heavens. He scattered the deeps of space with the glories of uncounted suns, the wonders of attendant planets and satellites. They all partake of His infinity. The stars of heaven are beyond the computation of man; the stars of God are to us *innumerable.*

With this new view of the infinity of God's shining orbs, we have a new realization of that truth which declares that there shall be, like the stars, vast numbers of those who shall wash their robes and make them white,—a great multitude no man can number. To create the innumerable suns, God had but to speak the word. The whole host of them obeyed "the breath of His mouth." But to bring forth the host of the saved, the Son of God left glory and eternal blessedness to lead men from sin to the purity of God. And we may be laborers together with Him in this work in these the closing hours of time.

God grant that we may be of that uncounted host, and that we may bring at least one other with us to swell the untold number. And God grant that we may see Him whose blood cleanses us white, and praise with immortal tongues both Him and the great and loving Father in the glory land beyond the stars.

CHAPTER XIV

The Fixed Stars

TO the unaided eye, the stars seem to hold the same relative positions in the heavens from age to age. Orion and the Pleiades, Arcturus, and the twelve signs of the zodiac, are mentioned in the book of Job. If Abraham could once more look upon the skies we behold, he would see the stars as he saw them thousands of years ago, when God "brought him forth abroad, and said, Look now toward heaven, and tell the stars, if thou be able to number them." To the unassisted eye, not a single star seems to have moved from its place.

This seeming fixity of place misled men for a time. It was supposed that the stars had no proper motions of their own. But in time, it was discovered that the planets, including the earth, are in motion about the sun; the satellites were in motion about their planets; and the comets were ranging the mighty orbits through the skies. Where there was so much motion, the question arose, Are the stars fixed as they seem to be? Have they no motion of their own?

"Before it became possible to examine with absolute certainty the places of the stars, with a view to ascertain their absolute fixity, many difficult preliminary preparations had to be accomplished. Instruments of the most perfect kind must be provided, not only in their optical performances, but in their space-dividing machinery. Moreover, the places of the stars, as determined by the best telescopes, must be corrected for every possible instrumental error. The two points to which the stars are referred are the north pole and the vernal equinox. In case any motions belong to these points, their amounts and directions must be ascertained and allowed for. Then the effects of refraction, and of the aberration of light, were indispensable to a perfect investigation of the absolute places of the stars.

"All these and many other preliminary matters having been satisfactorily determined, it became possible to examine, in the most critical manner, the places of the stars, and to learn whether indeed (as had been supposed for thousands of years) their configurations were eternal and unchangeable, or whether they moved among themselves with a motion rendered so slow by their immense distance, as hitherto to have escaped the most scrutinizing watch.

"Fully armed with the necessary instruments, it did not require many years to determine the grand truth, that among the ten thousands of stars which fill the heaven, not a solitary one, in all probability, is in a state of absolute rest. Many were found to move so swiftly that their velocity was determined in a single

Great Star Cloud in Sagittarius

Region of the Great Nebula of Rho Ophiuchi
"Upon a cloudless, moonless night, we look above us."

year; while others, in consequence of their enormous distance, may require centuries to detect any appreciable change. In the outset, these extraordinary movements seemed to be directed by no law — some stars were sweeping *in one direction,* and *some in another.*

"Motion, ceaseless, eternal motion, seems to be stamped on the entire universe; and while the stars are pursuing their mighty orbits, we cannot resist the idea that our own sun, the center of our great planetary system, itself a star, must participate in the general movement, and is, in all probability, urging its flight, accompanied by all its planets, satellites, and comets, to some unknown region of space.

"When forced to acknowledge the rotation of our globe on its axis, and its swift orbital motion, surrounded by wheeling planets and flying comets, the mind naturally retreats to the sun as the great immovable center, where it can rest and contemplate these circling worlds. But even here there is no rest. The sun himself is a subordinate member of a grander combination of worlds, and, obedient to higher influence, sweeps around in its immeasurable orbit.

"Herschel succeeded, at least approximately, in sounding the profundities of the Milky Way, and fixed the relative position of our own sun among the stars by which it is surrounded. He found it to be located not very far distant from the center of the great stratum, and near the line where the principal current of stars divides into two great streams which for a time separate from each other, but finally reunite in a distant region of the heavens.

"Having accomplished this much, this great astronomer attempted the resolution of the grand problem of the sun's movement through space. This investigation is so lofty, so daring and utterly incomprehensible at the first glance, that its mere announcement produces little effect on the mind. Consider for one moment what it involves. Man is located on a planet almost infinitely larger than himself. This planet is swiftly revolving on its axis, and in its orbit round a great central luminary, the sun. The daring philosopher participates in all these motions. He provides himself with instruments which measure the distances and positions of the almost infinitely distant fixed stars. These fixed stars, when subjected to his critical examination, cease to be fixed, and are found to be moving with astonishing velocity in all directions. Among these he numbers his own sun; and although borne along in the progressive motion of his own great center, he ventures to attempt the determination of the fact of its actual motion, the direction in which it moves, and the velocity with which it is sweeping through space.

"After as extended an examination as the data with which he was then furnished permitted, Herschel announced his belief that the solar system was moving through space toward a point in the constellation of Hercules.

"The announcement of this astonishing result was received with hesitation and doubt by the best living astronomer, and Herschel died before any confirmation of his great theory had been obtained. After his death,

for nearly half a century, no mind seemed willing to renew the investigation. The theory fell into disrepute, and was only regarded as a bold and sublime speculation, but not founded on any well determined observations."

During the present century, the problem has engaged the attention of some of the distinguished astronomers of Russia. "Argelander, of Bonn, led the way, and by a train of reasoning based upon extensive and accurate observations, has sustained and demonstrated, in the most undeniable manner, not only the general truth of Herschel's theory, but has even confirmed the direction in which that astronomer believed the solar system to be moving."

The final result of Argelander's work settled probably forever the grand fact that the sun, with its entire cometary and planetary system, is sweeping through space toward a point whose place must fall somewhere within the circumference of a circle whose diameter is about equal to four times that of the moon.

"The reality of the solar motion once determined, astronomers have not been wanting to verify and extend this wonderful examination. Argelander's results have been confirmed by the investigations of M. Otho Struve, the son of the distinguished director of the Imperial Observatory of Pulkovo; and if, on any fair night, you direct your eye to the constellation of Hercules, and select from its stars the two marked on the globe with the Greek letters π and μ, on the line joining these stars, and at a distance from π equal to one quarter of the distance which divides the stars,

will be found the point toward which the sun was directing his course in the year 1840."—*"Planetary and Stellar Worlds," Mitchell.*

"About twenty different determinations of the point in the sky toward which this motion of the sun is directed have been worked out by various astronomers, using in their discussions the angular proper motion of from twenty to twenty-five hundred stars. All the investigations present a reasonable accordance of results, differing from each other only by a few degrees, and show that the sun *is now moving toward a point in the constellation of Hercules, having a right ascension of about 267° and a declination of about 31°. This point is known as the 'apex of the sun's way.'"*—*Young's "Astronomy."*

Having found the *direction* of the solar motion, the next question was its *actual velocity.* It will hardly be wise to attempt an explanation here of the method by which this result was sought. But this much has been determined: The velocity of the sun in its course through the heavens has been found to be such as would carry the sun and its system about 5″ in 100 years, as seen from the average sixth magnitude star (the sixth magnitude being the smallest easily visible to the naked eye). If we knew the distance of this average sixth star, we could translate the motion of the sun into miles. But we can only estimate with some degree of accuracy the distance of the average sixth magnitude stars. On the reasonable assumption of Ludwig Struve, that this distance is about 20,000,000 times the astronomical unit, the velocity of the

sun's motion through space is nearly *sixteen miles a second.*

"And now do you demand how much reliance is to be placed on this bewildering announcement? I answer that as to the reality of the solar motion, there is not one chance out of four hundred thousand that astronomers have been deceived. We cannot resist the evidence; and startling as the truth appears, we are obliged to yield our assent, reluctant though it may be, to the logical reasoning by which this magnificent result has been demonstrated.

"But whither is our system tending? If moving onward with such tremendous velocity, is there not danger that erelong it may reach the region of the fixed stars, and by sweeping near the other suns and systems, derange the order of the planetary worlds? Let us examine this question for one moment, on the hypothesis that the sun alone is moving among all the stars of heaven, and that it will hold on in its present direction until it shall reach the star in Hercules toward which it is now urging its flight. This star is one of the third magnitude; and according to our statement already made, the mean distance of its class is such that its light does not reach us in a period less than forty-six years. Executing the calculation, we find that in case the solar system should continue to progress toward the star, it cannot pass the enormous interval, even at 33,550,000 miles per annum, in less than 1,800,000 years!

"If the eye of any superior intelligence can behold this amazing scene, how stupendous must be the spec-

tacle presented! In the center the sun, blazing with splendor, pursues its majestic career; around it roll the planets, and about it cluster ten thousand fiery comets. Worlds bright and beautiful hover near the sun; worlds fiery and chaotic seek this great center with impetuous velocity, and then dash away into the farthest range of their grand revolution. But the monarch moves on, and his magnificent *cortege,* performing

MOTION OF ARCTURUS

1. Arcturus in the days of Abraham. 2. Arcturus as it appears now. Although it is moving over two hundred miles a second, star distances are so vast, and this star is so far from us, it seems hardly to have moved at all during these thousands of years.

his high behests, follow whithersoever he leads through space!"

"Look out to-night on the brilliant constellations which crowd the heavens. Mark the configurations of these stars. Five thousand years ago the Chaldean shepherd gazed on the same bright groups. Two thousand years have rolled away since the Greek philosopher pronounced the eternity of the heavens, and pointed to the ever-during configuration of the stars as proof positive of his assertion. But a time will come when not a constellation now blazing in the bright conclave above us shall remain. Slowly, indeed, do these figures on the dial of heaven mark the progress of time. A thousand years may roll away with scarce a perceptible change; even a million years may pass without effacing all traces of the groupings which now exist; but that eye which shall behold the universe of the fixed stars when ten millions of years shall have silently rolled away, will search in vain for the constellations which now beautify and adorn our nocturnal heavens. Should God permit, the stars may be there, but no trace of their former relative positions will be found."

"Go backward in imagination to the plains of Shinar, and stand beside the shepherd astronomer as he vainly attempts to grasp the mysteries of the waxing and waning moon, and then enter the sacred precincts of yonder temple devoted to the science of the stars. Look over its magnificent machinery; examine its space-annihilating instruments, and ask the sentinel who now keeps his unbroken vigil, the nature of his

investigations. Moon, and planet, and sun, and system, are left behind. His researches are now within a sphere to whose confines the eagle glance of the Chaldean never reached. Periods, and distances, and masses, and motions, are all familiar to him. But where does the human mind now stand? Great as are its achievements, profoundly as it has penetrated the mysteries of creation, what has been done is but an infinitesimal portion of what remains to be done."—*"Planetary and Stellar Worlds," Mitchell.*

Over twenty-five hundred years before Herschel discovered the motion of the sun, God placed on record the astounding fact: "In them [the heavens] hath He set a dwelling place for the sun, which is as a bridegroom *coming out* of his chamber, and rejoiceth as a strong man to run a course. His *going forth* is from the extremity of the heavens, and his *coming about* unto the termination of it." Ps. 19: 4-6, literal translation.

This passage has given edge to many a sneer, because it was supposed to teach that the sun moves around the earth. But the Bible asserts that the earth moves around the sun. This scripture teaches the higher truth that the sun itself obeys the law enforced upon the planets, and flies in an orbit of its own, from one end of heaven in Argo to the other in Hercules. Only one hundred years ago did astronomers discover this great fact. The sun had no motion, and the Bible was an ignorant old book. But after herculean labors, astronomers find that the old Book was right, and that their science was behind. The sun does move.

And some men saw occasion for stumbling in the use of the word "tabernacle." "In them hath He set a tabernacle for the sun." They thought of a tabernacle as a tent, and that the idea of the verse was to suggest a closed place in which the sun resided as in a tent. This tent, of course, was the dome of the sky. They said there is no crystal dome above us, as thought the ancients. In this passage we have evidence, said they, that the ignorance of men wrote what now we know is not the truth. But it is loose reasoning indeed that can gather this from the text.

The word translated "tabernacle" came from a root word meaning *to shine*. Tents white and shining in the sunlight were thought of in connection with this word; and a new word, "tabernacle," was thus derived from the root word "shine." Therefore the root idea of the word "tabernacle" is not essentially *a tent,* or *covering,* but rather *a thing that is conspicuous from a distance*. As a tent was conspicuous, it was designated by a word derived from the word "shine." But there were other words in Hebrew which meant a tent, or tabernacle; and if this was the essential idea in the mind of inspiration, it is strange that such a word was not employed. But the word that is here used has a peculiar fitness. Our science only helps us to get the full significance of the term which inspiration saw fit to employ. Follow this carefully: At one time, there was not this word "tabernacle" in the Hebrew, but there was a word meaning *to shine*. In Bible lands, the dwelling places were to a large extent tabernacles, or tents. As men saw their tents from a

distance shining in the sunlight, they began to call them "shines." A new word was thus added to the language. But in time, men forgot, perhaps, the old idea in the verse, and thought of the word as meaning merely a dwelling place. Yet the idea of a covering, or covered place, was not an essential part of the word.

Now, do you see the appropriateness of this word? In the heavens "hath He set a tabernacle." The heavens are not in the tabernacle, but the tabernacle is set *in the heavens*. But in the heavens has He set a dwelling place; a shining dwelling place; a dwelling place conspicuous from a distance, as the white tents on the plain; a dwelling place for the sun. In other words, the Creator has ordained that the sun shall dwell in the heavens, and the shining of its fiery ball makes its dwelling place conspicuous from a distance. If the tabernacle was first so called from the fact that it was conspicuous from a distance, shining in the light of the sun, shall not the abiding place of the sun itself be so called? It shines; it is conspicuous; ten thousand worlds look forth to see its shining place in the heavens. "In them hath He set a tabernacle for the sun."

But the sun is only one of the stars. If the sun is in motion, are not the stars also in motion? *They are in motion.* It has been but a few years since astronomers knew this definitely, but it has stood on record in the Bible for hundreds of years.

"Lift up your eyes on high, and see who hath created these, that *bringeth out their host* by number." Isa. 40:26, A. R. V. What is this but an assertion that

all the hosts of the heaven are in motion? And it says more than simply that they are in motion; "that bringeth out their host *by number.*" They all move; but more, they move *by number;* it is a mathematical affair. And how fully has astronomy demonstrated the truth of this! Men used all the mathematical knowledge in their possession in attempting to follow and trace the paths of the heavenly bodies; and in more than one instance, they were compelled to invent *new* branches of mathematics, to conceive *new* methods of calculation. Thus were born analytical geometry and calculus.

In order for us to understand this one expression, "bringeth out their host by number," we must know something of the mighty work of Kepler, and of the three laws of motion which he discovered; of Newton, and of the laws of gravitation which he taught the world. In fact, we have before us, in these words in the Scriptures, all of mathematical astronomy.

But men had no more than discovered the movements of the heavenly bodies, than seeming irregularities and perturbations began to create doubts as to the stability of the universe. For a number of years, men thought that the universe had been so badly constructed, and was such a rickety concern, that it could not hold together long enough to get fairly started.

Again they showed how little faith they had in that Word which declares, "For that He is strong in power; not one faileth," or as the German has it, "His ability and strong power are so great that not one of them can be wanting." Isa. 40:26. There *were* seeming irregu-

larities in the movements of the heavenly bodies. There were perturbations and oscillations, accelerations and retardations. A top oscillates to indicate that it is about to fall. The earth was found to oscillate. The sun was found to do the same. Were they stumbling in their orbits? Were they about to fall and go to ruin? The Word said that not one of them can fall; but infidels and scoffers began to predict a final clash as the wind-up of things terrestrial and celestial, nor were they slow in insisting that the Bible was evidently but the work of man, since it teaches something so different. And the churchmen seized upon the idea to show the final wreck at the end of the world.

But it was left to an infidel to prove the truth of the Word through Isaiah. Laplace was a man gifted with extraordinary mathematical ability. He showed, by mathematical calculations and demonstrations, that every acceleration is compensated, after thousands or millions of years, by a corresponding retardation, and *vice versa*. He announced, as the result of his researches, that, so far as he could see, and so far as indications were concerned, the universe might exist forever.

We have already spoken of the endurance of the heavenly bodies, according to the declaration of the Word. Inspiration declares that because God's "ability and strong power are so great," not one shall fail. We believe it. And we are glad that science has advanced far enough to confirm this truth. But if it had not, what would your position and mine be to-day?

Would we, if we were living back before the days of Laplace, hold to the statement of that Word, or would we follow the crowd of worldly-wise men? There is a certain answer to the question: If you are *now* making that Book your science, if *now* you believe it in preference to all science and all the wisdom of the world, we may be reasonably certain that you would have believed the words of Isaiah *then*.

But the idea that the universe of God is yet to meet with ruin or partial wreck, is still taught. Men teach that some day the sun will grow cold and die, and the planets will whirl on in lifeless gloom. But the Word says that "His ability and strong power are so great" that not *one* of them can be wanting. And against the picture which scientists present — a picture of darkness and death — the Word places its prophecy of a brighter sun and a better world.

Manifestly there is to be a ruin, but it is the ruin of sin. There is to be an end to this world, not as a planet rolling in space, but as the resting and brooding place of sin. And then, beautified and made new, it will roll on, wrapped in brighter glory than in these days of misery and evil. Let nothing touch your faith in that Word. If it goes from your heart, you lose the truest guide man ever had.

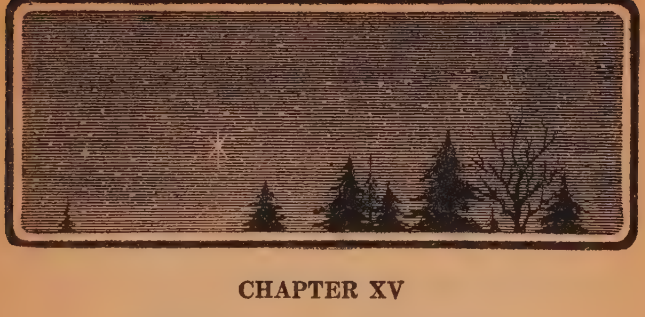
But the sun is whirling on through space. Astronomers have known this a trifle over one hundred years; but the Word has affirmed the same truth for almost three thousand years.

The stars are not fixed, as was long supposed, but are traveling each his destined way, some with a ve-

locity of two hundred miles a second. Astronomers have not long known the stupendous fact; but ages ago the Word declared them to be brought out by number. Thus in one passage in the Word, we are told more astronomical facts than we can demonstrate by the combined labors of the mightiest intellects during many generations.

I have no desire to belittle science. It is indispensable. It has a noble work. It "opens to the mind vast fields of thought and information." Science has its own peculiar province. It has a work to perform after its own peculiar methods to its own special ends. The Word of God was never meant to supplant it, nor to interfere with it. But it was meant to be an aid; and by suggestions and plain declarations, it is an all-efficient aid. Without it, we are left wholly to our own speculations and our own blind guesses; by it, we are led to take the right way and to move ever on in the investigation of truth.

God is as much the Author of science as He is the Author of the Bible. True, men hate His way, and long to disprove His statements; but their investigations always show that God is true. Let us not add to His words, lest He reprove us, and we be found liars. (Prov. 30:6.) He has certainly reproved men in this matter of the motion of the stars. It is always unsafe to dispute His Word. Let us rather believe it, for it will vitalize our science, and save our souls.



CHAPTER XV

The Bands of Orion

"CANST thou bind the sweet influences of Pleiades, or loose the bands of Orion?" Job 38:31. Some have sought to explain this expression from the Bible by the fact that the Pleiades are seen in the evening in the spring, and that this has some reference to the old idea that the Pleiades ushered in the sweet influences of the spring. To the student of the Bible, who understands how free from all such inferences the Bible is, such explanation is far from satisfactory. This very freedom from the childish notions of heathenism, is the best evidence that the Bible was inspired by a knowledge greater than that of the men of its times.

In this scripture, the difficulties resolve themselves into the one principle: If we know positively the meaning of the original word from which "sweet influences" is translated, it is possible to understand clearly the whole scripture. Looking up this word carefully in the Hebrew, we find it to be *maadannoth,* which means, *"a bond; that is, a group."*

From this, it is evident that the translators were not willing to take the first and most obvious meaning of the word. The scripture was too far ahead of the science of astronomy for the translators to grasp the high meaning of the original, and so it was translated in accordance with the prevailing notions of the times. But under the light of advancing science, man's knowledge of the stars has increased. The American Revised Version gives the language very clearly. It reads as follows: "Canst thou bind the cluster of the Pleiades, or loose the bands of Orion?" A marginal translation is suggested that would make it read, "Canst thou bind the chain of the Pleiades?"

Reading the scripture as thus given in the American Revised Version, one sees that it assumes the knowledge that the Pleiades and Orion are each a group, a family of stars, bound together. The Pleiades is a cluster. It is bound together as with an invisible band. Likewise the power that holds the great constellation of Orion into a great family of united stars is spoken of as its "bands."

At once the mind of the student of the Word rests in the assurance that science will find something here to verify this scripture. He is so certain of the infallibility of the Bible, that he does not question for a moment the truth of this language, but looks with confidence to science for its verification. If science has not advanced far enough to do this work, he waits for the facts to be developed that will elucidate and confirm the Word, though they may not come in his time.

Brooks's Comet, as Seen Just Before Dawn

This is but one of the impressive sights frequently spread in the heavens to delight the eyes of earth's dwellers.

THE CONSTELLATION PLEIADES, SHOWING NEBULOSITY

The nebula in the Pleiades was first revealed by photographs. It enmeshes the great stars of this cluster, and indicates that these belong together in one family. Modern astronomy's testimony is that, as the Bible says, there is a "sweet influence" which "binds" them into one group.

Now it has been scarcely a generation since men learned that the Pleiades and Orion were each a group of stars traveling through the depths of space, held, as it were, by some mighty chain. We will give some of the statements of prominent astronomers which will verify this text from the Word of God. We first give a quotation from "Other Worlds than Ours," published by Richard A. Proctor, astronomer and author, as early as 1870. He says:

"Among other instances may be cited the nebula round the stars c1 and c2 in Orion. In this object two remarkable nebulous nodules centrally surround two double stars. Admitting the association here to be real (and no other explanation can be reasonably admitted), we are led to interesting conclusions respecting the whole of that wonderful nebulous region which surrounds the sword of Orion. We become certain that the other nebulæ in that region are really associated with the fixed stars there; that it is not a mere coincidence, for instance, that the middle star in the belt of Orion is involved in nebula, or that the lowest star of the sword is similarly circumstanced. It is a legitimate inference, from the evidence, that all the nebulæ in this region belong to one great nebulous group, which extends its branches to these stars. As a mighty band this nebulous region seems to gather the stars here into close association, showing us, in a way there is no misinterpreting, that these stars and the nebula form one system."

The astronomer, judging only by appearances revealed to the eye, concluded that these stars made up

a community; but since that time, much more refined observations have been possible. By means of the spectroscope, astronomers are able to learn the very material of which the stars are composed; and here is what a fairly recent astronomer has to say concerning the revelations of the spectroscope with reference to Orion:

"The stars in Orion (with the notable exception of Betelgeuse) have a special variety of spectrum scarcely found outside of that constellation. This indicates that these stars have a similar structure; probably they are 'chips off the same block.' "— *Howe's "Descriptive Astronomy," page 237.*

This statement of the astronomer, we see at once, is more definite and convincing than the former one, and shows that as science has advanced, astronomy has been able more and more clearly to confirm the fact revealed in the Bible more than three thousand years ago. It is a long time to wait for confirmation, but it is one of the strongest conceivable evidences of the reliability of the Word of God. Many texts in the Bible were given to be understood in the closing age — "they are written for our admonition, upon whom the ends of the world are come." 1 Cor. 10:11.

Another writer presents even more clearly and conclusively this wonderful truth of the bonds of affinity which exist between the stars in the constellation of Orion:

"We sometimes think that those groups of stars to which from all antiquity certain names have been assigned have bonds of affinity, and that their proxim-

ity on the heavens is not to be attributed to a mere casual arrangement, but is to be taken as indicating a community of origin. In some cases there can be no doubt that this is so. In the great group of Orion, for instance, to which I have already referred, modern researches demonstrate that the several stars of that grand constellation possess a structure which may be described as peculiar to themselves, inasmuch as a similar structure has only been observed in one other star in the sky except those of Orion. In this case we have the evidence not only of juxtaposition in the heavens, but also of an allied material composition. Under these circumstances it seems almost impossible to doubt that the glorious assemblage of stars forming the constellation of Orion does really represent portions of a mighty system. If any further corroborations of this view be required, it may be obtained from recent discoveries with respect to the peerless nebula by which Orion is most familiar to astronomers. The beautiful photographs which have been obtained by Mr. Roberts and by Mr. Common have tended to disclose ever widening boundaries to the great nebula when sufficiently long exposure has been given. We thus see that the glowing gas encroaches on the surrounding space to an extent much wider than mere eye observation would have indicated. Several of the bright stars are already seen to be invested with whatever glory residence in the interior of a glowing nebula may confer. Adding this circumstance to those we have already mentioned of juxtaposition and of material congruity, it seems impossible to doubt that

Orion, the finest constellation in the heavens, is not a mere fortuitous concourse of stars, but is a system possessing indications of a common origin."—*"In Starry Realms," by Sir Robert S. Ball, D. Sc., LL.D., F.R.S., pages 265, 266.*

This presents clearly all that is needed for us to understand the expression "the bands of Orion." A full commentary on the text will be given at the close of this argument.

Now just a few words regarding the cluster of the Pleiades. Are the stars in the Pleiades also yoked together as a family? Over two hundred years ago an observer argued for their connection in one community, and the more searching investigations of science confirmed the fact.

DIAGRAM OF THE PLEIADES

The arrows indicate a common motion for the stars of the Pleiades, showing them to constitute one family, or cluster.

"The grouping of even six stars visible to the naked eye in so small a space is very remarkable. Considering the number of stars visible in the whole sky without optical aid, Mitchell, writing in 1867, calculated by the mathematical theory of probabilities that the chances are 500,000 to 1 against the close arrangement of the six stars in the Pleiades being merely the result of accident. He therefore concluded that 'this distribution was the result of design, or that there is reason or cause for such an assemblage.' Modern observations show that his conclusion was sound. The common 'proper motion' of a large number of the stars composing the Pleiades shows that they are in some way physically connected."—*"Studies in Astronomy," by J. Ellard Gore, pages 69, 70.*

"Most of the brightest stars of the Pleiades are also moving in one and the same direction, and this community of proper motion has received the name 'star drift.'"—*"A New Astronomy," by David Todd, page 430.*

Clearly as this statement presents the fact, the argument offered in the following quotation is perhaps more convincing:

"In a similar way we are entitled to infer that many other remarkable groups of stars give evidence of a certain physical connection which corroborates the presumption obtained from the fact that the stars happen to be close neighbors. I do not suppose that any one ever could have doubted that so striking a group as the Pleiades had some natural connection. But if there were such doubts they must be dispelled when the

photographs of the Messrs. Henry and of Mr. Roberts show the seven stars of the Pleiades to be immersed in a single nebula, invisible to the eye, and perceptible only to the delicacy of the photographic plate. In other famous groups also there are indications of relationship drawn from their common movements. If seven fish were seen together in the sea there would be a certain presumption that they formed a related group, and this presumption would be greatly strengthened if it should appear that all the fish were swimming in parallel directions. We can sometimes apply a similar principle to the study of a constellation. If seven bright stars lie comparatively near each other in the sky, and if it be found that they participate in a common motion so far as direction is concerned, we may not unnaturally conclude that these stars belong to an organized system, and that they are not merely a number of discrete objects scattered promiscuously on the sky."—*"In Starry Realms," by Sir Robert S. Ball, D. Sc., LL. D., F. R. S., page 266.*

Regarding this common motion, Young's "Astronomy" (page 459) says: "The brightest stars in Pleiades are found in the same way to have a common motion. In fact, it appears to be the rule rather than the exception that stars apparently near each other are really connected as comrades, traveling together in groups of twos and threes, dozens, or hundreds. They show, as Miss Clerke graphically expresses it, a distinctly '*gregarious* tendency.'"

From the same book, page 501, we take this expression:

"Of the naked-eye clusters the Pleiades is the most interesting and important. To an ordinary eye six stars are easily visible in it. Eyes a little better see easily five more. A very small telescope (a mere opera glass) increases the number to nearly a hundred; and with large instruments more than four hundred are catalogued in the group. A few of the stars apparently in the cluster are really only accidentally on the same line of vision, and are distinguished by proper motions different from those of the rest of the group; but the great majority have proper motions nearly the same in amount and direction; they have also identical spectra, and therefore undoubtedly constitute a single system."

Having thus seen how wonderfully modern facts agree with this scripture, ages old, we have a strong evidence that the scripture was really inspired by a knowledge greater than that common to humanity at the time it was written.

By this scripture, the mind of man is challenged. Attention is called to two great families of stars moving majestically in the heavens. The constellation of the Pleiades is pointed out, and the wonderful fact that the stars making up this constellation — immense, brilliant suns, every one of them — are bound by the great band instituted by the Creator. We have at once before us a most extraordinary work. All these suns, some of them greater than our own, have been put under an influence — a sweet influence, if you will — that extends from one to the other, and holds them each in sympathy with the other. Moving through

space more swiftly than a fast-flying cannon ball, they yet each feel the presence of their fellows; they obey this instinct to keep together.

Then consider the tremendous work that produced this wonder — the constant power that forever impresses these stars so that they fail not to obey. As we contemplate this marvelous spectacle, God asks, Could you do such a thing? "Canst thou bind into a cluster, by a sweet influence, a chain, the Pleiades?" Each one of us knows himself to be absolutely inadequate for such a gigantic task. Only God could do it. Only God has done it. And He who thus upholds this starry cluster, this vast portion of the universe, will do as much for the great family of human beings that are also moving, moving down the corridors of time, and who should also be bound together by sweet influences, by a chain that would make them helpful to one another. In the church of Christ, we find as great an association, or even a greater, where the bond is so close that if one member suffers, the others suffer with him. The God that made the seven stars and Orion, cares for us.

"Canst thou . . . loose the bands of Orion"— mighty stars whirling through space? The distances between them are so great as to appall the mind; still across that distance there is a great band of God's own creation, invisible, yet indissoluble. Can you loose it? Can you break asunder the power that holds these vast suns together? Can you dispel these stars that through the ages are moving untiringly, held together by one common, unexplained sympathy?

No, man never could group such a community of stars as the Pleiades; neither could he tear asunder such a cluster as Orion. His puny arm could do naught against even one of these rolling suns. No, if all the strength of every arm of every person that has ever lived upon this earth were assembled in the might of one great arm, it could not even start this little world of ours in its orbit path. Much less could it attempt anything with the sun, which is capable of engulfing thousands of earths like ours.

We trust in Him who has done such wonderful things, knowing that "there is nothing too hard" for Him.

CHAPTER XVI

Arcturus with His Sons

"CANST thou guide Arcturus with his sons?" Job 38:32. This quotation from the ancient book of Job is a marvelous one, and the facts brought out by modern astronomy reveal its import in a manner both striking and significant. In this thirty-eighth chapter of the book of Job, God challenges the might and wisdom of men as contrasted with His own perfect power and unlimited wisdom. He points to examples of His marvelous working in the universe, and bids us think how little is all that we can do as matched against the infinite accomplishments of the Creator.

We should also learn another lesson from these words of the ancient book. They were written at a time when astronomical knowledge was extremely meager. Let us consider some of the knowledge necessary to use this language and conform it to facts.

One who wished to speak thus would have to know first of all that the stars were in motion. This of itself, at that time, would have been a startling gener-

alization. From limited records we have of those days, we see that there was no such idea then prevalent. The understanding of star distances and star motions was entirely outside the ken of the ordinary mortal. Therefore a person who would ask such a question as the one we have quoted, must rise above all the astronomical knowledge or ignorance of his time, and declare that the stars were moving, and further, were under guidance of the Creator of their movement. Again, it would be necessary for him to know that some of the stars were moving much more swiftly than others; and further, he would have to know at least one of these more swiftly moving bodies, and be able to name it. This the Word does without hesitation. It selects that brilliant star Arcturus. It is the fourth or fifth brightest star in the heavens. Yet the speaker selects this star, calls man's attention to the fact that it is moving with extraordinary power in its position in the heavens, guided by the infinite hand of the Creator; and the question is asked, Could you do a thing like that?

Furthermore, there was then no means by which man could measure either star distances or star movements. Such a work required the telescope, fitted with a micrometer, and it required a knowledge of mathematics not in vogue at that time. The Chaldeans, who possessed the bulk of astronomical knowledge in those days, could not survey land unless they actually passed over it with the measuring rod or line. Our present system of triangulation they did not have; and so we know that they did not have any such knowledge

as is manifested in the Word, and they had no means of obtaining it, and what they did write about the stars and the heavens was childish nonsense as compared with this dignified reference to astronomical fact.

But the Spirit of God, which "searcheth all things," even "the deep things of God" (1 Cor. 2:10), knows all the facts existing in this vast universe; and it selected one of the grand facts of astronomy, and expressed it in words of final knowledge that will never go out of date, no matter how far astronomical science may advance.

Standing not long ago in an astronomical observatory, talking with the director of that observatory, who is a noted man, yet a devout Christian, I said to him, "How could men know enough to make this allusion?" He answered: "They did not know enough. There was no way for them to know it." Then, to get his answer, I asked, "Whence came this question?" "Ah," said he, "that came by the inspiration of the Word of God. It is an infallible evidence of the absolute knowledge and truth contained in that book."

Now what do we know, in these latter days, regarding this wonderful star, that brilliant, shining orb, Arcturus? Astronomers have found that all the stars apparently are swiftly moving — moving through the great depths of space like swarms of bees, each in its own course. They have found that these movements average a speed as great as that of the swiftly flying cannon ball, or even greater. The average motion of the stars is ten miles a second. This is a marvelous velocity. That of our fastest express trains, going

a mile a minute, or sixty miles an hour, is as nothing compared with it. Ten miles a second is six hundred miles a minute. Therefore the velocity of the stars is six hundred times that of our fastest trains. A body traveling at this rate would go from New York to Chicago in a little more than a minute, or from New York to San Francisco in less than five minutes.

Such a velocity the mind cannot grasp. It is impossible to picture, for the eye has never seen anything from which the mind could make the picture. Such is the velocity of the stars. Such is the speed that our own sun is making through space every second of time. At his unflagging velocity, it moves ten or twelve miles while you are reading one sentence.

But what do you think of a star that transcends in velocity this movement that we have indicated? The sun moves, as we have said, ten miles a second; but Arcturus flies away at the incomprehensible velocity of 257 miles a second, or nearly twenty-six times as fast as our sun. Let us compare this tremendous velocity with distances on the earth, and the motion of a fast train. Instead of going a mile a minute, like our express trains, Arcturus travels at the enormous speed of 15,420 miles a minute. This would carry a body around the world, or 25,000 miles, in a little over a minute and a half. The mind cannot grasp the awful movement depicted in these figures.

But that is not all there is to consider in this connection. Momentum, or the power to produce movement, and therefore the power to stop it, is measured by the weight multiplied by the velocity. We have the

velocity of Arcturus, 257 miles a second. What about its size?

As has already been stated, Arcturus is the fourth or fifth brightest star in the heavens. This brightness is not due to its nearness to us. For example, Venus is sometimes bright enough to be seen in daylight. This is because of its nearness. The light travels such a short distance, comparatively, that it appears very bright to us, whereas it is not nearly so bright as that of the faintest of the stars. They shine more faintly because they are at such extremely great distances from us.

Arcturus shines with a very brilliant light, but it is very far from us. In fact, it is so far that astronomers have not been able to get its distance with anything like accuracy. They know, however, in a general way, something about its distance; that is, they know that it is no nearer than certain measurements which they have been able to make. How much farther away it is, they cannot say.

Basing their knowledge on this kind of generalization, astronomers have concluded that Arcturus is probably a thousand times larger than our own sun.

But our sun is no pygmy when compared with sizes familiar to us. We can get some idea of its bigness if we realize the following facts: The moon makes a circle about the earth at a distance from the earth of about 240,000 miles. If it were possible to place the earth in the center of the sun, with the moon at the same distance from the earth as now, both the earth and the moon would be hidden entirely within the ball

of the sun. But great as the sun is, we must multiply this figure by one thousand to get a ball big enough to match Arcturus.

Since momentum, as we have said, is measured by velocity multiplied by the weight of the moving body, the momentum of Arcturus must be 25,700 times as great as the momentum of the sun, for it is one thousand times as large, and moves 25.7 times as swiftly.

Ah, is it strange, then, that inspiration selected this particular star? Is it strange, then, that God challenges men and points out man's littleness as compared with the power of the Creator? In this instance of Arcturus, what a lesson there is for us — the lesson, first of all, that God's Word contains infallible knowledge, facts above the science of the times in which it was written, facts beyond the ken of unassisted mortals. That one verse in Job stands like a beacon on a mountain top, and points men to the fact of its inspiration.

And we must learn the lesson, too, of the unmeasured might of Him who can guide, yea, who can give impulse of movement to, such a star, and with that star, all that belong in its train.

We cannot account for the stupendous movement of this apparently runaway star by the laws of gravitation. Astronomers have studied the matter carefully, and have given it up as a hopeless task. The attractive power of every star and world and satellite in the universe neither could start Arcturus into such a headlong pace, nor stay it one iota in its magnificent sweep through the limitless bounds of space.

And more, man cannot guide it, cannot understand its guidance, cannot account for that guidance by any mathematical or mechanical means; he must confess that God controls and moves this giant on its way, or that there is no explanation of the extraordinary phenomenon.

And if men, all men, yea, every human being that ever lived on this planet, could unite in one gigantic effort, could concentrate all the energy of all the muscles that ever worked beneath the sun, into one grand effort to stay Arcturus in its course, that effort would be as futile as to shoot a paper wad against a fast flying express train.

We must respond to the challenge of the Almighty, to this question of inspiration: No, we cannot guide Arcturus and his sons. It is not in us, in any of us or all of us, to guide him in his majestic march through the heavens; but the Lord can and does guide him. "For that He is strong in power, not one is lacking." Isa. 40:26, A. R. V.

"The hand that bears creation up,
Can guide His children still."

NEBULA IN CYGNUS

This dainty streamer of glowing wisps of light seems to defy the astronomer's effort to analyze.

THE SURFACE OF THE MOON

The large picture shows how the earth would appear to an observer on the moon's surface. The smaller views illustrate some of the "craters" on the moon, and two theories regarding their formation.

CHAPTER XVII

The Gospel of Despair

THERE is one idea advanced by astronomers, which, tried by the Word of God, is utterly erroneous. I feel inclined to call it the everlasting gospel of despair. It is the idea that the sun and all the stars must one day grow cold and die. True, according to the speculations of these scientists, that day is very distant; but they say it is nevertheless quite certain. Some day in the remote future, the sun and the stars will roll on in space, cold as icicles, and dead as cinders.

"If nothing intervenes to reverse the course of things, the sun must at last solidify, and become a dark, rigid globe, frozen and lifeless among its lifeless family of planets. At least, this is the necessary consequence of what now seems to science to be the true account of its present activity and the story of its life."

"One lesson seems to stand out clearly,—that the present system of stars and worlds is not an eternal one."—*Young's "General Astronomy," page 524.*

"Sooner or later the sun must become a dark globe, no longer fiery and radiant, no longer the source of heat and light to his family of worlds. The dazzling photosphere must lose its glowing brightness; and at length our sun will be a sun no longer." "One fact seems clear, past the possibility of mistake,— that not only our little earth, not only the solar system, but the whole vast stellar system, the universe of stars, so far as we can know anything about it, is a changing, fleeting, dying universe."—*"Radiant Suns," pages 307-309.*

Scientists offer these ideas as mere theories and speculation, and are not dogmatic about them. They admit that there may be means by which the sun and the stars will have their existence continued; there may be some way by which their life is renewed; but scientists know nothing of it. Yet they constantly throw out cautions concerning this profound question of which they know so little.

"In these matters occupying the dubious borderland beyond scientific certainties, we have to be cautious; we must be willing to wait, willing not to be sure. At best, our outlook is very partial and dim. The connecting link between us and each far-off, glimmering point consists of only a few rays of light. We can watch those rays; we can subdivide them; we can analyze them; we can decipher a little of the make and of the movements of the star or nebula from which they come,— and yet how small is the sum total of our information!"—*Id., page 421.*

"May we not receive even the teachings of science as to the 'laws of nature' with the constant memory

that all we know, even from science itself, depends on our very limited sensations, our very limited experience, and our still more limited power of conceiving anything for which this experience has not prepared us?

"I have read somewhere a story about a race of ephemeral insects which live but an hour. To those that are born in the early morning, the sunrise is the time of youth. They die of old age while its beams are yet gathering force, and only their descendants live on till midday; while it is another race which sees the sun decline, from that which saw it rise. Imagine the sun about to set, and the whole nation of mites gathered under the shadow of some mushroom (to them ancient as the sun itself) to hear what their wisest philosopher has to say of the gloomy prospect. If I remember right, he first told them that, incredible as it might seem, there was not only a time in the world's youth when the mushroom itself was young, but that the sun in those early ages was in the eastern, not in the western sky. Since then, he explained, the scientific ephemera has followed it, and established, by induction from vast experience, the great 'law of nature,' that it moved only westward; and he showed that since it was now nearing the western horizon, science herself pointed to the conclusion that it was about to disappear forever, together with the great race of ephemeræ for which it was created.

"What his hearers thought of this discourse I do not remember, but I have heard that the sun rose again the next morning!"—*"The New Astronomy."*

Thus we find that science has nothing definite to offer. We must go elsewhere if we would know the truth of these things. Are all worlds limited in their period of existence? Has God built the universe to last but a season? Did He place the suns upon such a basis of existence that they must ultimately become exhausted? Is the world one day to become as barren as the moon now seems to be? Is the sun to become as dead as a cinder and as dark as the shadows of forgetfulness? Science, so-called, says Yes; the Word of God says No.

God gave the sun to rule the day, and the moon to rule the night. (Gen. 1:16.) He says: "If ye can break My covenant of the day, and My covenant of the night, and that there should not be day and night in their season; then may also My covenant be broken with David My servant, that he should not have a son to reign upon his throne." Jer. 33:20, 21. This covenant of day and night involves the sun and the moon; and the covenant with David is the promise of Christ. In another place, God speaks of these same things: "My covenant will I not break, nor alter the thing that is gone out of My lips. Once have I sworn *by My holiness* that I will not lie unto David. His seed shall *endure forever,* and his throne *as the sun* before Me. It shall be established *forever as the moon,* and as a *faithful* witness in heaven." Ps. 89:34-37.

This is a promise of the eternal reign of Christ, the Seed of David; and God makes that reign coexistent with the sun and the moon. Christ's throne is to be "a faithful witness in heaven."

The promises of God in Christ are as enduring as the sun and the moon. Do you believe that Christ's kingdom will be an everlasting kingdom? Then you must believe that the sun and the moon will endure as luminaries through the same unending ages. The sun and the moon perform their work by the delegated power of God. They are just as enduring as the kingdom of Christ. God's promises in Christ are just as sure as the ordinances of the sun and the moon. If either goes, both go. All things are in Christ; and all that He upholds, remains while He remains. They are upheld "by the word of His power." By Him they all consist.

Think you there is any danger that the sun and the moon will fail?—Oh, no! "By the greatness of His might, and for that He is strong in power, *not one is lacking.*" Isa. 40:26, R.V. "His ability and strong power are so great that not one of them can be lacking."—*German Bible.* "By the greatness of His might, and strength, and power, not one of them was missing."—*Latin Vulgate.*

They cannot fail. He is too strong to allow any of His work to go to ruin. The laws of God in respect to the heavenly bodies are as inviolate as the law written and engraved on tables of stone. His promises concerning the things of nature are as certain as His promises to your soul.

The sun is one of the stars. We are told that the stars are to shine forever. "And they that be wise shall shine as the brightness of the firmament; and they that turn many to righteousness *as the stars for-*

ever and ever." Dan. 12:3. In one particular, those who turn many to righteousness are to shine as the stars. That one particular is here specified — they, like the stars, are to shine "forever and ever."

Instead of the sun's growing colder and darker, it is to be even brighter in the promised days of God. The moon is not to lose its light, but to shine far brighter when the sun takes on its sevenfold radiance, in the days of restitution. "The light of the moon shall be as the light of the sun, and the light of the sun shall be sevenfold, as the light of seven days, in the day that the Lord bindeth up the breach of His people, and healeth the stroke of their wound." Isa. 30:26.

Thus in various ways and in numerous places has God revealed, in clear and unmistakable language, the future of the universe. Scientific speculation, by the little data it has gathered, certainly has misread the truth. It has misread the truth because it lacks some essential fact or facts. But God's Word discerns all facts, and has given us the truth which conforms to the facts. Let us not be troubled by the speculations of men while there is left to us the immutable Word of God. No true science opposes that Word; for God's Word is science.

"There is a recognized tendency in all high-class energy to deteriorate to a lower class. There is steam in the boiler, but it wastes without fuel. There is electricity in the jar, but every particle of air steals away a little, unless our conscious force is exerted to regather it. There is light in the sun, but infinite

space waits to receive it, and takes it swift as light can leap. We said that if the sun were pure coal, it would burn out in five thousand years, but it blazes undimmed by the million. How can it be? There have been various theories: chemical combustion, it has failed; meteoric impact, it is insufficient; condensation, it is not proved; and if it were, it is an intermediate step back to the original cause of condensation. The farseeing eyes see in the sun the present active power of Him who first said, 'Let there be light,' and who, at any moment, can meet a Saul in the way to Damascus with a light above the brightness of the sun — another noon arisen on midday; and of whom it shall be said in the eternal state of unclouded brightness, where sun and moon are no more, 'The glory of the Lord shall lighten it, and the Lamb is the light thereof.' "—*"Recreations in Astronomy," by H. W. Warren, D. D.*

Light was created at the beginning; God spoke, and, lo, it was! "He commanded, and it stood fast"— continued as it was. (Ps. 33:9.) Let me repeat: He bade light be; it was. And at this, its first appearance, it was but energy from God — a manifestation of God through Christ.

Now mark the next step: God issued the fiat that, as light had come, so it should continue. When it came at the first command of God, it was energy from God — God's manifestation. Then God commanded that as it had come, so it should continue, or "stand fast." Still it is energy from God; it is still a manifestation of God in Christ. The same power that made

it first appear, still feeds it. Thus the shining of light is a *continuing of the creative act;* it is a *prolonging of creation.* Watch the effect of light in spring days upon the bursting buds and springing grasses, and you will not doubt the truth.

How God can continue to do this and not exhaust Himself, is a silly question. Does God lose anything? — The conservation of energy is a law to which we know no exception. In the universe of God, nothing is lost. The leaves on this year's trees may fall and wither and decay; but they only drop into the earth to enrich the soil, to feed the leaves that are to come again in some later years. Water is continually leaving the ocean and entering the clouds, later to fall upon the earth and bathe and refresh it; but every drop in time gets back, to go once more the selfsame round. Shall God send light and heat out into space, and shall it be thereby lost to Him, and beyond His power to gather it again? Perhaps He does not care to gather it again; it may serve other uses. We are sure, however, that it is not lost.

"Through faith we understand that the worlds were framed by the word of God." The word that framed the worlds called light into existence. That is all we know about it: it was by the word of God. Light came in obedience to God's word; and now it continues because He gave His command. By the utterance of His word, God produced all that fills His boundless universe; and in the same manner, He can cause the sun to produce light and heat through the untiring ages. The sun shines on, but it is not consumed.

Moses, in his day, beheld a wonder when "the angel of the Lord appeared unto him in a flame of fire out of the midst of a bush: and he looked, and, behold, the bush burned with fire, and the bush was not consumed."

That was a marvelous thing. "The bush burned with fire, and the bush was not consumed." That was a stupendous miracle. But in the heavens above us every day, we see the same wonder,—a wonder that is to be perpetuated throughout the rolling cycles of eternity. The sun, with all its blaze of heat and light, ever burns, to bathe the earth in its rays, and give light and energy to all its creatures. And it is not consumed.

No wonder that men, having lost sight of God, worshiped the sun; but let *us* look up and away from the central orb of our solar system, to Him who is the center of the universe, the source of all we are or ever hope to be, and whose tender mercies are over all His works.

CHAPTER XVIII

Difference in Glory

"IT used to be thought that the stars were all very much alike in magnitude and constitution; not, indeed, without considerable difference, but as much resembling each other as do individuals of the same race."— *Young's "Astronomy."*

That one star shines more brightly than another was always apparent. But men thought that one star was brighter than another simply because it was nearer to us. They did not believe that the difference in the radiance of different stars meant an actual difference in the stars themselves.

But there came a time when men learned that this explanation was not sufficient. There might be instances where one star was brighter than another simply because it was nearer; but as the distances to the stars came to be measured, it was found that sometimes a very bright star is actually many times farther away than another star very inferior in brilliancy.

Alpha Centauri is about two hundred and thirty thousand times farther from us than is the sun. This

star has a companion which emits about one sixth as much light as itself. According to the most careful estimate of the brilliancy of Alpha Centauri, the light we receive from it is about $\frac{1}{16,950,000,000}$ of that which we receive from the sun. But if the sun were removed to a distance equal to that of Alpha Centauri, it would shine with only $\frac{1}{52,900,000,000}$ part of its present brilliancy. It follows, therefore, that the star emits about three times as much light as the sun. A man situated at Alpha Centauri would see the sun as a star one third as bright as Alpha Centauri appears to us. Here is a difference which cannot be accounted for by a difference of distance.

Take for another example the light of the star Sirius. Because our sun is much nearer than Sirius, it is much brighter. Sirius is considered to be half a million times farther away than the sun. If the earth were midway between the places these two bodies now occupy, the sun would give us one twelfth the light now given by Sirius, and Sirius would shine four times brighter. Since four times twelve is forty-eight, it follows that Sirius is forty-eight times brighter intrinsically than the sun.

By similar reasoning, it is judged that if Alpha Centauri were removed to the distance at which 61 Cygni lies from us, although thereby its light would be diminished to one ninth of its present value, it would nevertheless outshine either component of the double star 61 Cygni more than eleven times.

In these instances, distances would not account for the difference in brightness. There appears to be an

actual difference in the stars themselves when placed at equal distances from us. Men had a ready explanation for this. It showed, they said, a difference in size. Assuming this, the diameter of Sirius may be held to exceed that of our sun in the proportion of about fourteen to one, or to have a diameter of nearly twelve million miles, and a volume two thousand six hundred and eighty-eight times as great as the sun's.

But is this second explanation, joined with the first, able to account for the difference in star luster? — No; there is still another factor. Astronomers have found that there is one more characteristic of the stars which they must not overlook if they would be with the facts.

"The differences of brightness are due, *first,* to difference of *distance; second,* to difference of dimensions, or of light-giving area; *third,* to difference in the *brilliance* of the light-giving surface, depending upon difference of temperature and constitution. . . .

"As Bessel puts it, there is no reason why there may not be 'as many *dark* stars as bright ones.' . . . The companion of Sirius, though only giving about one twelve-thousandth part as much light as Sirius itself, is at least one tenth part as heavy; so that, *mass for mass,* it cannot be one one-thousandth part as luminous."

In the case of Sirius and its companion, we have two stars equally distant, or nearly so, from us. But by investigation regarding the perturbations in their orbits through their mutual attraction, which is directly as the mass, it has been ascertained that Sirius is about ten times the heavier; and careful measure of the light

we receive from them respectively, proves that Sirius sends us twelve thousand times as much as the companion star. It is thus easily found that in proportion to its mass, the companion star is not one thousandth part as luminous as is Sirius.

These are the findings of modern astronomy. Students of the skies have at length reached the great and final truth that "one star differeth from another star in glory," or radiance. It took much patient, careful, accurate investigation, and it took time, to gather sufficient facts to get at last to the great truth. But the student of the Word was told, nearly two thousand years ago, that one star differs from another star in radiance. Here was the great truth, given by the God who made the stars. Here was a truth which comprehended the facts. But men refused to credit the truth until they could find it through the facts.

Had they believed the Word, and conducted their investigations in its light, doubtless it would have been to them an invaluable aid. When that faith entered, knowledge of the truth would have come with that faith. The only thing left to do would have been to find the facts. But God knew that it would be ages before the facts could be gathered one by one. For our own best good, He left us to search them out; but to keep us from ignorance during the interval, He gave us the eternal truth. And astronomers, though they should live everlasting years, would never be able to revise or amend this simple statement of God.

One star differs from another in brilliancy. An accumulation of facts, and very careful reasoning from

them, have brought us face to face with the fact that one star differs from another star in luster. It must be so, not because the fallible judgment of man asserts it, but because that Word which is above man's judgment, and which is above all man's science, and which is ever and forever true science, declares it so.

The Word tells us that "one star differeth from another star in glory." No two stars are alike. And the great difference in the stars, the Word announces, lies in the difference in their glory. This says to us, Would you know the difference between one star and another? Study their glory, for therein lies their difference.

The word "glory" in the Bible means essentially character and radiance. I will not attempt to show this here, but a careful study of the term will reveal the fact. Glory means character; but it always carries the idea of luster, brilliancy, light. The relation of character and brightness as embodied in the word "glory," seems to be that of cause and effect; the brightness is the outshining, or manifestation, of the character.

And so the passage says to us: One star differs from another star in character and brilliancy. Study that luster, examine that light, if you would know the difference in character of the stars one from another. One star differs from another star in glory, and that means for you that there is a difference in their light. Study that light, and you will know their difference.

As we study the difference in a number of artificial lights, there is one difference that first of all attracts our attention. If a candle, a lamp, an electric light,

and an acetylene light, are placed at equal distance from the eye, and the light in each case is of the same size, the spot of brightness in each case will be of the same size. But the brilliancy is not equal. The candle is quite dim, the lamp shines a trifle brighter, and the acetylene and the electric light, though possibly smaller in size than the other two, far outrival them in brilliancy. One light differs from another in brightness.

Carrying our investigations to the regions of the skies, as we are to find the difference in the stars one from another by the difference in their light, we ask, Is one star brighter than another? And after long and careful search and much thinking, astronomy answers that some stars are much brighter than other stars, even as an electric light outshines a candle. One star differs from another star in *radiance,* or *brilliancy.*

Let us go back to artificial lights and begin a new investigation. We burn salt in a white light — the light turns from *white* to *yellow.* We mix alcohol and boracic acid and ignite them — a beautiful *green* flame results. In the same way, alcohol and nitrate of strontia give *red* flame. In these experiments, a difference in the character of the thing consumed gives a difference in the light emitted.

Again turning to the stars, we wonder if we shall find anything like this in the light they emit. We discern that Aldebaran and Betelgeuse shine with a bright *red light;* Sirius, Regulus, Vega, and Spica are *white;* Procyon, Capella, and Polaris are *yellow.* As a difference in the character of the objects giving out the artificial light gave a difference in color, so astrono-

mers argue that a difference in the constitution of the stars gives a difference in their light. It has also been learned that vapor affects the color of the light passing through it. And in heating an iron, we notice that it at first is a dull red, but becoming hotter, emits a white light. Thus we reason by analogy that there may be a difference in the character of the stars or in the vapor about them, producing the difference in color.

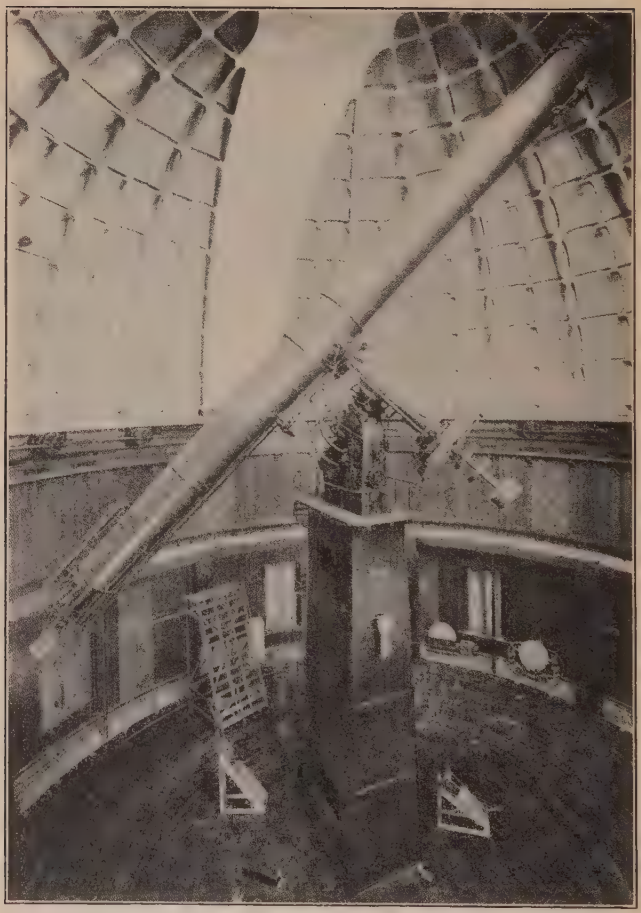
What is all this study but a careful investigation that was commenced and outlined in the Bible statement that "one star differeth from another in glory"? Studying that glory, we may have been led up to some idea of the difference in the stars themselves. "We are charmed with the variegated flowers of our garden of earth; but He who makes the fields blush with flowers under the warm kisses of the sun, has planted His wider garden of space with colored stars. 'The rainbow flower of the footstool, and the starry flowers of the throne,' proclaim one Being as the Author of them all."—*H. W. Warren.*

But there are other differences in light; and by this difference, we learn of new differences in the heavenly bodies. The passage under consideration tells us that "there is one glory of the sun, and another glory of the moon." Then the reason follows: "for one star differeth from another star *in glory.*"

We are here told that the glory of the moon is one glory, and that the glory of the sun is another glory. To demonstrate it, we gather up the light coming from each, and look for the difference in that; because the sun differs from the moon *in its light.*

SIRIUS, A CELESTIAL FURNACE

The most brilliant star in the heavens. Many times larger and brighter than our sun. It has an almost invisible companion that revolves around Sirius in about fifty years.



THE 36-INCH LICK TELESCOPE

"If the direct light of the sun be received upon a plate of polished black glass, it can be reflected *in any direction* upon the walls of a room. The *character* of light thus reflected is *radically changed*. The properties of the reflected ray are *not now symmetrical* around the ray. There *are certain directions* in which it *cannot* again be reflected."—*Appleton's "Physics."*

Light coming from the sun can be reflected in any direction by a mirror or by a plate of polished black glass. This is an essential of light coming from the sun, or, for that matter, from *any self-luminous body* —the light can be reflected *in any direction.*

But light that has once been reflected cannot be again reflected in *every* direction. There is one plane in which it refuses to be again reflected. It is then said to be polarized. When two mirrors are set so that the light of each is incident at an angle of 54° 35′, *no light will be reflected* from the second mirror; a black spot will appear in the field of view. If the mirrors are kept at this angle, and the upper one is revolved about a vertical axis, the light will grow brighter until the mirror has turned 90°; then it grows feeble continuously until the mirror has turned another 90°, when it is again *wholly* extinguished.

To discover whether light is reflected, an instrument called the polarscope is used. By means of this instrument, we may examine a given ray of light, and know definitely whether the ray has come direct from some self-luminous body, or if it has been reflected. Applying this investigation to the light that comes from the moon, we find that the moon shines by re-

flected or borrowed light; and by the same means, we can always determine whether light from the heavenly bodies is reflected from planets and moons, or emitted by suns.

The Creator determined, in the constitution of light, that bodies reflecting light should not be mistaken for those which are self-luminous. The light of the moon is essentially different from that of the sun; otherwise we should certainly have been deceived as to the character of these two heavenly bodies. But God will not deceive; He will not even allow a deception in the works of His hands.

But He who created light and gave it all its properties knew just what these properties are. He knew that the glory of the sun was not the glory of the moon, and He told us that "there is one glory of the sun, and *another* glory of the moon," for one differs from the other *in glory*. We ought to have believed in His Word. He made light so that it would bring us the message of this difference in the sun and the moon, and then He sent us the same message in His Word. Had we not been set in our own way, we would have received that message long ago, and our science must have been the better for it, and astronomy would thus have been far in advance of what it is. God does not want us to be in ignorance. From every side, He offers encouragement and inducement. He gives us most earnest invitation, "If any of you lack wisdom, let him ask of God, that giveth to all men liberally, and upbraideth not; and it *shall be given him.*"

But light reveals more wonderfully still a difference of one star from another; and this difference of one star from another, remember, is revealed by the difference in the light they emit. Light is supposed to be undulations in the ether. These undulations are very minute and of wonderful velocity. Let a ray of light, entering a dark room, pass through a glass prism. "It is instantly turned out of its course, some parts more and some less, according to the number of vibrations, and appears as seven colors in different parts of the screen."

"None of these in any sense are color, but affect the eye differently, and we call these different effects color. They are simply various velocities of vibration. An object like one kind of stripe in our flag, which absorbs all kinds of vibrations except those between 396 and 470,000,000,000,000, and reflects those, appears red to us. The field for the stars absorbs and destroys all but those vibrations numbering about 653,000,000,000,000 of vibration per second. A color is a constant creation. Light makes momentary color in the flag."—*H. W. Warren.*

But let us examine this spectrum of various colors rather than the theory which men advance to account for it. If we examine this band of colors spread out from the white ray of sunlight, we do not find each color simple. Red is not simply red, neither is yellow simply yellow, etc., but there are all along through the spectrum a vast number of fine microscopic lines of various lengths. They are parallel, in some places near together, in other places far apart, but always of

the same number and the same relative distance when the same light and prism are employed.

"A patient study of these signs of substance reveals richer results than a study of the cuneiform characters engraved on Assyrian slabs; for one is the handwriting of men, the other the handwriting of God."

As Warren has said, these lines are the alphabets to new realms of knowledge. They are produced by specific substances in the sun. Each substance has its own peculiar line or lines. Sodium always has two lines in a certain place in the yellow. Light passing through vapor of sodium has the vibrations that would fall on these two narrow lines in the yellow utterly destroyed, leaving instead two black spaces. Light passing through vapor of burning iron has hundreds of vibrations absorbed, leaving in their stead that number of black lines; but if the salt or iron is glowing gas, in the source of the light itself, the same lines are bright instead of dark.

By taking advantage of these principles, we can detect the presence of a large number of well-known terrestrial elements in the sun. The solar spectrum is crossed by dark lines, which, with an instrument of high dispersion, number several thousand; and by proper arrangement, it is possible to identify among these lines many that are due to the presence, in the sun's lower atmosphere, of known terrestrial elements in the state of vapor.

"Thus we have brought to our doors a readable record of the very substances composing every world hot enough to shine by its own light. We find in our

sun many substances known to exist in the earth, and some that we had not discovered when the sun wrote their name, or rather made their mark, in the spectrum."—*H. W. Warren.*

"The reader now understands that when the light from a celestial object is analyzed by the prism, and the component colors are spread out singly as on a sheet, the dark and bright lines which we see are the letters of the open book which we are to read so as to learn what they tell us of the body from which the light came, or the vapors through which it passed. When we see a line or a set of lines which we recognize as produced by a known substance, we infer the presence of that substance. The question may now be asked, How do we know but that the lines we observe may be produced by other substances besides those which we find to produce them in our laboratories? May not the same lines be produced by different substances?

"This question can be answered only by an appeal to probabilities. The evidence in the case is much the same as that by which, recognizing the picture of a friend, we conclude that it is not the picture of any one else. For anything we can prove to the contrary, another person might have exactly the same features, and might, therefore, make the very same picture; but, as a matter of fact, we know that practically no two men whom we have seen do look exactly alike, and it is extremely improbable that they would ever look so. The case is the same in spectrum analysis. Among the great number of substances which

have been examined with the spectroscope, no two give the same lines. It is therefore extremely improbable that a given system of bright lines could be produced by more than one substance."—*Newcomb's "Astronomy."*

Up to 1891, scientists, by means of the spectroscope, had determined thirty-six elements present in the solar atmosphere. Among these are the following well-known elements: calcium, iron, hydrogen, sodium, nickel, magnesium, cobalt, silicon, aluminum, manganese, carbon, copper, zinc, cadmium, silver, tin, lead, and potassium.

Astronomers expect in time to find present in the sun all the elements that are present in the earth. They have found some elements which, until their discovery in the sun, were unknown. Thus helium, coronium, and argon were found in the sun, but it was not known whether they existed in the earth. At once a search was made, and both argon and helium have been detected. In 1895, helium was at last identified by Ramsay, in connection with his researches upon argon. He found the lines of helium in gas discharged from uraninite and other minerals, where it is associated with the so-called "rare earths." Argon has been discovered in our atmosphere.

But as yet the most careful observation has failed to find in the sun the slightest trace of bromine, chlorine, iodine, nitrogen, arsenic, boron, or phosphorus. There are some doubtful indications of sulphur; and regarding oxygen, "the evidence, on the whole, is against its presence, though the case is peculiar."

What a marvelous message is this which light brings to us in its analysis! The light from glowing substances is in no two cases alike. Burning iron gives out hundreds of bands in the spectrum, sodium two, and other elements but one. We do not expect to find the spectra of two elements to be the same, any more than we expect to find photographs of two different persons to look exactly alike. The Creator gave light this marvelous message. He endowed it with the power of revealing thus the absolute character of the thing emitting the light. And light was so endowed evidently for this very purpose, that it might bring us word of conditions in far-away worlds. And as no two elements give the same kind of light, and as probably no two stars have precisely the same elements in the same proportion, the light coming from the stars cannot be in any two cases precisely the same. The stars differ in their constituent elements. Every ray they flash forth bears in its very being signs of what they are. "Hence the eye of Omniscience, seeing a ray of light anywhere in the universe, though gone from its source a thousand years, would be able to tell from what orb it originally came."

As we are known by our doing, so the stars are known by their light. The eye of All-wisdom views a ray of light, and knows, as you know the words of this book, the marvelous message it carries. "One star differeth from another star." He who created them, sees their message in the light they emit. And He tells us to see that which may be seen; namely, that "one star differeth from another star in glory."

CHAPTER XIX

The Vastness of His Power

VERY few have any conception of the wonderful energies revealed in the material universe. Before we consider the forces manifested by the stars in space, let us for a few moments think of some of the marvelous energies at work close at hand.

Consider the air we breathe. We are not conscious of the power wrapped up in this invisible agency; yet it is held closely hugging the earth by the tremendous downward pressure of gravity. This pressure amounts to about fifteen pounds to the square inch. We do not feel it, for it is through us as well as about us. We are immersed in it. We are saturated with it. The whole pressure on this earth, expressed in tons, requires sixteen digits, being close to 5,517,823,961,480,000 tons. In round numbers, we may say it is five thousand millions of millions of tons. But this is but one letter, so to speak, in the alphabet of God's power in the world.

Consider next the rain. Listen to its patter. The drops mean an annual fall of millions of tons of water on the earth's surface. The average quantity of water

held suspended in the air at any time, is estimated to be more than 50,000,000,000,000 tons. The annual rainfall has been estimated to be about two hundred thousand cubic miles. If spread out equally at one time over the land portion of the globe, it would cover all the continents of Asia, Africa, Europe, and North and South America, with water twenty feet deep. All this enormous weight of water is lifted without sound or agitation or seeming effort.

What gigantic energy is this, that lifts tons as easily as we lift feathers! To such a power, removing mountains is mere child's play.

But the pressure of the atmosphere on the earth, or the pressure of the water that falls, is as nothing to the pressure of the water at the bottom of the oceans. At a depth of two thousand five hundred fathoms, the pressure is estimated to be two and a half tons to the square inch. Each one of those inches of water pressure would run twenty-five ordinary railway trains if it could be properly applied.

Yet the Word of God declares that He measures the waters in the hollow of His hand. Isa. 40:12.

Think next of the marvelous energy that operates throughout the vegetable world. In a single pulpy squash, Professor Clark, of Amherst, Massachusetts, demonstrated a power of two and a half tons. No one knows how much more it might have lifted, as the measuring apparatus failed at this point. All over the globe, this energy of vegetable life is constantly and untiringly exerted. The little daisy that blossoms in the meadow, the vast acres of wheat that wave in the

summer winds, each bunch of grass in the pastures, every cornstalk that rustles on the prairies, the shrub that ornaments the landscape, and every giant tree that wrestles with the wind,—these all show something of the stupendous power manifested by the vegetable kingdom.

But let us next consider the tides of power flowing down upon the earth in the genial rays of the summer sun. According to recent measurements, it appears that on every square yard of the earth's surface exposed perpendicularly to the sun's rays, in the absence of an absorbing atmosphere, there could be derived more than one horse power, if the heat were all converted to this use. At the equator, a steamer could be driven at a fair rate of speed, by utilizing only the sunshine that beats down upon its decks. On so small an area as Manhattan Island, or that occupied by the city of London, the noontide heat is enough, could it all be applied thus, to drive all the steam engines in the world. Thus we see that millions of horse power, unmeasured by man, are rained down upon us in the form of sunlight. If we were able to gather up this energy in some way and store it for use, daylight alone would furnish an inexhaustible supply of power.

The sun, besides supplying us with light and heat, keeps the earth always near it by the force of gravitation. Seldom do we think of the mighty pull it is always exerting upon this earth. It reaches out also to lay hold upon worlds much larger than ours, much farther away in the confines of space, and that travel in much vaster orbits; and these too it holds in an un-

breakable grip. To represent the power exerted between our earth and the sun only, we might in thought substitute wires for the invisible pull now existing. Each wire between the earth and the sun would have to sustain a pull of fifteen hundred pounds, three quarters of a ton; and they would have to be placed so close together all over the side of the earth exposed to the sun that a mouse could not run between them.

But this is a mere fraction of the power that works in the sun. And that shining orb is only a private, as it were, in the immense armies of the heavens. Besides it, there are suns upon suns, many of them much brighter and mightier than it.

The sun is only one of the luminaries of the sky. It has a train of worlds under its sway. Each star in the heavens is a sun; and though we cannot see the dim light of planets so far away, we are sure, from the example of our solar system, that other suns too have their loyal attendants. If we could take our station at one of these far-away stars, from those distant regions, our sun would dwindle into a tiny spot of light, and the very greatest of our planets would be entirely invisible, even through the largest telescope. Shining by reflected light only, the rays would be obscured in crossing but a small portion of the great abyss that intervenes. From that far-off viewpoint, our whole solar system would be reduced to the faint glimmer of a little star.

There is no good reason for us to doubt that the stars of the heavens have also their attendant worlds, although these are invisible to us from the earth. Out

there in space may be systems even vaster and more splendid than our own. As the stars are without number, so probably are these systems of worlds. Who, then, can measure the power of the Creator in this matter of gravitation between suns and worlds! God peoples immensity with His wonders, and reigns with majesty and might through the unsounded deeps of His unlimited dominions.

"Standing upon the latest found of all the planets, at a distance of more than 3,000,000,000 miles from the sun, we are able to look backwards, and examine the worlds and systems which are all embraced within the vast circumference of Neptune's orbit. An occasional comet, overleaping this mighty boundary, and flying swiftly past us, buries itself in the great abyss of space, to return after its long journey of a thousand years, and report to the inhabitants of earth the influences which have swayed its movement in the invisible regions whither it speeds its flight.

"The magnificence and complexity of the great system of planets, and satellites, and comets, which constitute the sun's retinue, the immense magnitude of some of these globes, their periods of revolution, and reciprocal action, would seem to furnish sufficient exercise, not only for the highest intellectual efforts, but for the entire energy which the human mind can exert. But the whole of this stupendous scheme, as we shall soon see, is but an infinitesimal portion of the universe of God, one unit among the unnumbered millions which fill the crowded regions of space. Standing on the verge of the planetary system, we find our-

selves surrounded by a multitude of shining orbs, some radiant with splendor, others faintly gleaming with beauty. The smallest telescopic aid suffices to increase their number in an incredible degree; while with the full power of the grand instruments now in use, the scenes presented in the starry heavens become actually so magnificent as to stun the imagination and overwhelm the reason. Worlds and systems, and schemes and clusters, and universes, rise in sublime perspective, fading away in the unfathomable regions of space, until even thought itself fails in its efforts to plunge across the gulf by which we are separated from these wonderful objects."— *O. M. Mitchel, "The Orbs of Heaven," pages 169, 170.*

But all this vast display of stars and worlds and clusters and universes but spells out the magic story of God's unmeasured power. The One who did all this can do anything. He is, indeed, omnipotent; for all that we see from this earth, by the eye or the camera, are but the suburbs of God's boundless dominions.

Think, too, of their motions through the oceans of space. On the earth, winds moving a hundred miles an hour are called tornadoes. They sweep everything clean in their path. But in the sun, there are tornadoes that travel more than a thousand miles an hour. How can we measure such energies?

On the earth, trains may run at the great speed of a mile a minute; but the sun and others of the stars travel twelve miles a second, or seven hundred and twenty miles a minute. Hardly any of them travel

slower than the flying cannon ball. The velocity of the stars is, on an average, six hundred times the speed of the express train that makes its mile a minute. New York to Chicago in a little over a minute! New York to San Francisco in four minutes! This is about the average speed of the stars.

But what about a speed of fifteen thousand miles in a minute!

The motion of Arcturus, which some have called the runaway star, is at this frightful velocity.

God's power is without measure. He is the Mighty One. Through the wide oceans of space, suns and worlds are spinning like tops, unceasingly in motion. They are hurled in orbits swifter by seventy times than the speed of the rifle bullet. They never move an inch out of their appointed paths, and never the fraction of a second out of time. Of this upholding might, Christ has said, "All power is given unto Me in heaven and in earth." "All power," yet who shall measure it!

We have, however, called up but a mere figment of the manifestations of God's power. What it really measures is all unknown to man. Could he essay to measure it, he would find it infinite. In the field of the Creator's activities, we have not as yet even learned our A B C's. It is impossible for us to spell out the first easy words, if such there be, in the sweeping vastness of universe power.

"Lo, these are parts of His ways: but how little a portion is heard of Him? but the thunder of His power who can understand?" Job 26:14.

CHAPTER XX

His Definite Foreknowledge

THE future — how it impresses humanity! What burden does it carry with which ultimately to crush us? What fulfillment of our hopes awaits within it? What will come to us out of its immensity? What will we ultimately lose?

It was this strenuous desire to penetrate the future which caused the God-forsaken Saul to seek out the witch of Endor. He anticipated and dreaded his fate in the coming battle, and he was determined to find out, if he could, the trend of events, even if he had to secure it from an agent of Satan. But the evil one does not of himself know the future. He may know some of the prophecies, and thus gauge certain events; or he may make shrewd guesses by reading the effect from the cause. But even here he is often frustrated, because at the last moment, God may send in some influence that directly changes the course of events.

In that wonderful chapter of Revelation in which the future is represented as a great sealed book, we

are told that no one could open it, or even look upon it, except the Lion of the tribe of Judah, the Lamb of God. Christ, as the representative of the human race, is the only one delegated of God to make known the history of the world in advance.

But there are those who deny even to God this ability to read the future. The fact that the future is a mystery to man, is no reason for us to say that God cannot foreknow. But if God did not know all that is coming, He would not be able to promise anything to His creatures. Because God foreknows all things, He is able to say to us just what He can and will do.

Any one who has even a fair knowledge of the Bible, knows that God reads and makes known the coming events. When Nebuchadnezzar was thinking about the days to come, God revealed to him in a dream the whole future history of the world, in a condensed form. Concisely and graphically, by six bold outline strokes of the master's brush, as it were, the whole future was painted: first Babylon; then Medo-Persia; next Grecia; following that, Rome; and after Rome, the divided empire; and last of all, the great stone cut out of the mountain without hand, destroying the image, becoming a great mountain filling the whole earth — this last a token of that everlasting kingdom which God will eventually set up to crown and end the history of the world.

All the great prophecies of the Bible — the whole book of Revelation, for example — portray the future. With so many of these prophecies already fulfilled,

Breaking Through the Mist

This illustrates something of the great power in the rays of the sun, which move almost unbelievable quantities of water every day.

NEBULA IN URSA MAJOR

Although it appears to be a whirling mass of light, astronomers fail to find any evidence of such motion.

it is too late now for any one to say that God cannot or does not read the future. He has outlined event after event, and these have come true accurately and precisely on scheduled time.

When a railroad company issues its time-table, that is a printed promise that a given train will be at a certain station at the appointed time. It is a promise for the future. These promises are, in general, fulfilled; but sometimes, because the events of the future are unknown, the company's plans fail. The trains do not arrive, or they come in late. It is not this way with the promises of God. When He told Abraham that his descendants would go down into Egypt, and remain there a definite time, God knew and read the future. And He revealed the future to Abraham. "It came to pass at the end of the four hundred and thirty years, even the selfsame day it came to pass, that all the hosts of the Lord went out from the land of Egypt." Ex. 12:41.

But now, as to the stars' demonstrating God's foreknowledge. An astronomer has said:

"If I were asked what is the greatest fact that the intellect of man has brought to light, I would say it was this:

"From the infancy of time, our solar system — sun, planets, and moons — has been flying through space toward the constellation of Lyra with a speed of which we have no example on earth. To form a conception of this fact, the reader has only to look at the beautiful Lyra, and reflect that for every second that the clock tells off, we are ten miles nearer to that constel-

lation. Every day that we live, we are nearer to it by almost, perhaps quite, a million of miles. For every sentence that we utter, for every step that we take in the streets, we are miles nearer to this star. We approached it by tens of thousands of miles while the writer has been penning these lines, and the reader has been carried nearer by a thousand miles while perusing them.

"Nothing can give us a better conception of the enormous distance of the stars than the reflection that notwithstanding the rapid motion, carrying unceasingly forward, . . . ordinary observation would fail to show any change in the appearance of the constellation toward which we are traveling. From what we know of the distance of Vega, we have reason to suppose that our solar system will not reach the region in which the star is now situated until the end of a period ranging somewhere between half a million and a million of years from the present time."—*Newcomb's "Astronomy for Everybody," pages 325, 326.*

But the earth will never find Vega, for Vega is also going on its own journey, and is passing away from its present position almost as fast as we are approaching it.

What is thus true of our own sun and of Vega is true also, so far as we know, of every star in the heavens. They are all flying swiftly, like balls shot from cannons. Indeed, it is a slow moving star that does not exceed the velocity of a cannon ball. The most common velocities are five to thirty-five miles a second. Yes, there are two stars, one of them Arc-

turus, whose velocity is somewhere around two hundred miles a second.

Yet the distances that surround these stars are so great that their enormous velocities seem very slow indeed. In a thousand years, if one could watch the heavens so long, we should find no appreciable change in the positions of the stars. They would seem to be exactly in the same places at the end of the time as they occupied at the first. In order to see any change at all, we should have to take the swiftly moving Arcturus, and observe it four thousand years. At the end of that time, it would seem to have moved only about one half of the distance shown between 1 and 2 in the diagram on page 150.

Let the heavens be studied on the first night after a man is born, and again on the first night after he has died, and no change in the relative positions of the stars can be discerned. Yet throughout this lifetime of man, every one of those seemingly steadfast orbs is moving so swiftly that in comparison, the speed of an express train, the flight of a bird, or the rush of a rifle ball, is as absolute rest. From age to age, they speed their way through the abyss we call the skies; yet an old man, looking at one of them, sees it just as he saw it when he was a little boy.

Let us get the marvelous vision of a restless universe. Stars unnumbered, millions upon millions of shining suns, attended by planets too dark in their reflected light to be seen by means of telescope or revealed by camera. Though their numbers rise in the scale of immensity we would fain call infinite, yet

every one of them has its ordained path in the heavens, fixed and settled for eternal ages. Their path is as definite as the track that the train runs on. But there is one great difference between the train and the stars. The train sometimes leaves its track and piles up in ruin. Not so with the stars. No star ever leaves its path. And no path ever fails a star. Because of the might of the Creator, not one of them ever can be missing.

But there is another thing we must add to the picture. The paths of the stars are not parallel lines. The stars are moving in many different directions, until they seem to weave in and out, could we watch them for ages, like a mass of bees around a hive. The asteroids, or minor planets, between Mars and Jupiter, are so thick, and their orbits so interwoven, that if those orbits were wires, nobody would be able to untangle them. Yet the astronomer sees these asteroids, every particle of star dust — for they are not much better — keeping their places in their appointed paths, never changing from them, never colliding or interfering, an object lesson close at hand of what is taking place on a larger scale throughout the starry universe.

But all this would be simply impossible were not God able to read the future, and see and determine where each heavenly body shall be in all the coming ages, and know that they can never collide or interfere with one another, or so settle to one side of the universe as to make it overbalanced or unstable. Astronomers, by combining the highest knowledge gained

in several hundred years, have been able to compute approximately the perturbations of the planetary worlds, and to predict roughly the return of half a score of comets; but God has computed the mutual perturbations of millions of suns, and planets, and comets, and worlds without number, not alone for the times gone by, but throughout all the ages that are yet to come. He has done this not approximately or roughly, but with perfect and absolute precision.

The whole universe is filled with restless motion, system after system, cluster beyond cluster, stars and nebulæ, worlds and comets, all sweeping in mighty paths, some in reverse order to others, the motions most complicated, the velocities most startling, of wheel within a wheel; and only God knows both the end and the purpose of it all, even from the beginning. All have been perfectly adjusted to time and place, to balancing perfectly forever the great material universe. Every globe has been weighed and poised in space, every orbit has been measured and given its beautiful curve. God has permitted a certain elasticity of relative position, a sort of rocking back and forth of the system; yet it never introduces disorder, and it never leads to destruction. But this flexibility of position makes the paths just so much the more complicated, just so much harder for us to determine, though they tax neither His wisdom nor His power the tiniest whit.

However, let us not weave into this conception any idea of individual fate. While the heavenly bodies obey His will, acting as a fine piece of machinery,

man is differently constituted. He is a free moral agent. He is to act as arbiter of his own destiny. Yet God's providences are as fully prepared for man as for the stars. As the poet declares, "Thine eyes did see my substance, yet being unperfect; and in Thy book all my members were written, which in continuance were fashioned, when as yet there was none of them." Ps. 139:16.

As we view all this display of power and wisdom, we see that it is directed to noble and beneficent ends. God is good, and His tender mercies are seen to be over all His works.

O pygmy soul amidst the vast immensity, lose not heart! If all this grandeur oppresses you with the thought of your smallness, turn away from the prodigious sweeps of space, and center your trembling faith upon the cross of Calvary. There behold the sacrifice of the Son of God, and in it the pledged love and care of Him who observes even the sparrow's fall.

The stars mark the mighty power and infinite wisdom of God; but the cross of the dying Christ marks the love of God, His so great love that paid for a sinner's redemption. It sets the price of a human soul.

We may say, then, with the poet:

"Behold this midnight splendor — worlds on worlds —
Ten thousand add, and twice ten thousand more;
One soul outweighs them all, and holds the seeming vast magnificence
Of unintelligent creation — poor!"

CHAPTER XXI

The Clock of the Universe

ETERNITY! What a word it is, standing as it does for unending duration! Yet, when we come to consider our conception of duration, we find that the mind cannot think of duration as other than endless. For instance, if we let the mind run back into the distant past, we cannot think to some time when duration began, and say, This was the first of it. The moment we thus attempt to set up a barrier, the mind assures us that it can think of just as great a period of duration beyond as we have previously measured off. And the thought comes that if we believe that these two periods are all there is to our conception of duration, we are mistaken, for the mind can conceive of just as many of these periods as it pleases. It can count them up into the millions and billions; and when it has thus grasped a new period, we care not how long, then the imagination runs out into the conception that all these almost measureless ages can be taken as a new standard of measurement, and multiplied as many times as we will, and this mental

process be kept up as long as the mind can work. But at no time have we been able to conceive of duration as not existing. The mind can conceive of duration only as eternal, stretching back forever, and stretching into the future forever, without "beginning of days."

But while duration cannot be limited by any beginning or end, it can be measured as it flows. That which measures duration, we call a clock or a watch or a chronometer, the last word meaning a measurer of time. When we study the heavens as if they were some gigantic clock, we find almost a promise of infinite duration. And this idea of the universe as a clock is not a mere figure of speech.

A captain is navigating a ship, we will say, from Liverpool to China. Frequently he must determine the precise location of his ship. If he were unable to do this, he could not find his way across the trackless ocean. Observations of the sun give him his latitude and tell him his local time. After he has obtained his local time, in order to find how far he has sailed west, he has but to find the difference between the local time and the Greenwich time, and reduce this time to degrees and divisions of a degree. Having turned the difference in time into degrees and fractions of a degree, he can readily reduce it to miles and fractions of a mile.

For example: There are 360 degrees in a circle; hence 360 degrees measure the entire circumference of the earth. Then one degree is one three hundred and sixtieth of the circumference of the earth. Roughly, the circumference of the earth is 25,000

miles; and one degree would be 25,000 divided by 360, or about 69 miles, at the equator. North or south of the equator, the circle of the earth being smaller, the degree is smaller; so that half way from the equator to the pole, it would be very nearly 49 miles; and at the pole, it would be nothing. One degree of latitude would be slightly over 69 miles, practically anywhere the observation might be taken.

The sun completes a revolution of the earth in twenty-four hours; hence it passes over 360 degrees in this time. In one hour, it passes over 15 degrees; and in four minutes, over one degree.

To ascertain the Greenwich time, the ship carries a chronometer that has been carefully rated before starting; and often two or three chronometers are provided, to guard against the risk of error, for an error may be very serious. An error of even one minute might lead the ship fifteen miles out of its course. But we will suppose that the chronometer is correct; that is to say, it points to twelve o'clock when the sun is on the meridian at Greenwich. The captain makes his observation of the sun on the meridian where he is; and we will suppose that when he does this, the chronometer points to three hours fifty-two minutes. This difference of time means a difference in longitude of fifty-eight degrees. Knowing the latitude, the captain turns to his table, and sees just how many miles there are in a degree of longitude at his latitude. If he wishes to translate his course into miles, he can readily do so. But if he wishes merely to know his location, he has but to look at his chart for the assigned latitude and

longitude, and he can put his finger down and say the ship is right there.

If he fears that his chronometer is not correct, he can test it by the clock of the universe.

Now there is such a clock, and it keeps Greenwich time, even though the captain is many miles from England; and he can look at the face of this clock any cloudless night, and read the time, no matter where he is. Then if his chronometer has lost or gained, he can correct it by the great clock of the universe. What do we mean by all this?

The face of this gigantic clock is in fact the face of the starry heavens. The numbers on the dial are, by this same figure of speech, the twinkling stars; and the hand that moves over the dial is nothing but the moon itself.

When the captain desires to test his chronometer, he measures the distance of the moon from a certain neighboring star. He discovers, perhaps, that the moon is three degrees from some star; and in the nautical almanac, he finds the Greenwich time when the moon is three degrees from this star. Comparing this with the indications of the chronometer, he finds the required correction.

There are other indications which cause us to call the universe a clock. On all clocks, there are several means by which we ascertain the different divisions of time. There is an hour hand, a minute hand, and a second hand. One division measures five minutes by the big hand, and one hour by the small hand. One revolution of the dial by the big hand measures an

hour, and fractions of it; and one revolution of the dial by the little hand marks twelve hours, and fractions of them. But the heavens have more devices for measuring duration than any clock ever made by man. Let us consider some of these.

You will find, as we consider these measurements, that the periods of time marked by an ordinary clock reveal the smallness of the doings of men; while the measurements of the clock of the skies mark the greatness of the doings of God.

1. By the clock of the skies, one rotation of the earth upon its axis, shown by the positions of the sun, measures off a day.

2. One revolution of the moon about the earth gives us the lunar month of about twenty-eight days.

3. The revolution of the earth in its orbit around the sun gives us the year of 365¼ days.

These are measurements that any one can observe and easily understand. But there are others on a larger scale. Some of them run into hundreds and thousands of years.

When we consult an astronomical almanac, we notice that the eclipses are given in it for a whole year. These predictions of the lunar eclipses are reliable, because astronomers have been carefully observing the moon for ages, and in tracing its path thus far, are able to project the path it will make in the future. No wonder that the Bible calls the moon "a faithful witness in heaven."

4. There is one leading principle regarding eclipses which is so simple that it can be easily understood.

For example, if we view all the eclipses in a period of eighteen or nineteen years, we find that after this time, the eclipses repeat themselves for another similar period. Hence if we observe all the eclipses in a period as indicated, then we can predict quite nearly all the future eclipses for a long time to come, for the eclipses will apparently repeat themselves after the stated period of time. This period of repeating eclipses is 6,585⅓ days. This number of days after one eclipse, another similar one occurs. This period is called the saros. The exact length of a saros is 6,585 days, 7 hours, and 42 minutes.

5. The sun also follows the moon's example, and repeats its eclipses. Since the solar ecliptic is larger than the lunar, a solar eclipse has from sixty-five to seventy returns, occupying some twelve hundred years, so that the sun's marking on the dial of the clock of the skies is a period of time over one thousand years in length. There is no such large division as this on the dial of men's clocks.

6. There is another division of time marked by the clock of the skies. It is indicated by the nutation or nodding of the earth's axis. Twenty-five thousand years are required for one wobble of the pole of the earth; and during this time, the moon will have wobbled fourteen hundred times. Twenty-five thousand years for one rotation of the pole! The large cycle is called the precession of the axis of the earth; and the nodding back and forth is called the nutation.

7. The major planets give us some interesting periods of time. Their revolution around the sun requires

more time than the earth's. Mars marks off a division on the clock of the skies by a revolution in about 687 days, or a period well along toward two of our years. Jupiter requires 4,332 days, or something over eleven years. Saturn's period is nearly 30 years; that of Uranus, more than 84 years; and Neptune's, nearly 165 years.

8. There is still another great period of time marked off on the dial of the skies, but I cannot tell you its length. It is the gigantic period indicated by one revolution of the sun around its center, wherever that may be. The sun is moving over ten miles a second — yes, better than seven hundred miles a minute. It carries all the planets of our system with it at this astounding pace. An express train makes perhaps a mile a minute, but the sun moves over seven hundred miles a minute. Yet its orbit is so vastly large that astronomers cannot detect the slightest curvature in it. The sun seems to be moving in a straight line; but we are sure that this cannot be, for every path yet found for a heavenly body is a closed orbit, unless we except some of the comets. The great bodies of the skies move in circles or ellipses.

How many æons of ages it will require for the sun once to encircle its mighty orbit, no man can say. But the fact of such a monstrous cycle of time on the dial of the clock of the skies tells us something of those ages which belong to Him who "inhabiteth eternity." From everlasting to everlasting is the measurement of His existence; and that which He has made shadows forth something of the greatness of His infinite years.

And if we were able to measure the time required by the sun to make one circle of the center around which it revolves, we might find other suns that require vastly longer periods to compass their orbits. Out of the innumerable stars that glimmer in the heavens, there are infinite possibilities for the measurement of mighty cycles. Thus the clock of the universe may ever be marking off the eternal ages of God, and never be nearer the end than it was before.

And endless though that duration may be, God will never change. He is the same yesterday, to-day, and forevermore. It is from His unchanging faithfulness that we gather our lessons of hope and trust.

And the Word declares that the one who does God's will shall abide forever. He shall live while the sun, hurrying on its 700 miles a minute, traverses the mighty orbit marked out for it in the heavens, though it may be countless millions of millions of *ages* of *ages*. And when that time has gone by, and the sun is making the second cycle, the child of God can say, "I still have just as many ages to live as I had when the sun began so long ago." And no matter how many millions of ages the circuit of the sun may require, and no matter how many times the sun may circle this orbit round, there has been nothing taken from the infinite ages of the immortal life; for eternity has never an end.

And O, to think of it, beloved, "He that doeth the will of God abideth forever." "They that turn many to righteousness [shall shine] as the stars forever and ever."

CHAPTER XXII

God's Dwelling Place, Where?

ASTRONOMY has revealed almost infinite depths to the stellar universe, stars and systems extending through space without end. The universe is vast. Its infinitude reflects the infinity of its Maker. God rules His universe; over and over again we have seen examples of the might of His sway. From His high throne, in the midst of His universe, by invisible rays of power and influence, He is perfectly in control of it all.

Some seem to think that if God be considered as a personal being, seated somewhere upon a throne, such vestiture of personality and definite location divests Him of universal presence and power. But there is no need that it do anything of the kind.

Neither is it logical and reasonable to take the pantheistic idea that God can be universally present only if He be a divine Spirit or essence merely, pervading all things. Such a view, no matter what its exponents may say in words, immerses God in His creation. It drowns Him, so to speak, in His own works.

Personality is the mightiest factor in the universe. But to say that God is not a person, as some modern religionists do, in harmony with the teachings of pantheism for ages gone, is to say that we have something infinitely greater than God has. And the reason that the position is taken is really because the human heart is pleased to think that there is no personal God to whom it is responsible. As such view the subject, each is a part of God, for all is God. And wherever such a view has undisturbed course, it leads to the lowest depths of moral debasement and corruption; for anything that one does (thus they finally come to consider it) cannot be wrong, because all are parts of God. Some are already boldly teaching this, as in the following poem:

"For all is good if understood
(Ah, could we understand!);
And right or ill are tools of skill
Held in His either hand.

"The harlot and the anchorite,
The martyr and the rake—
Deftly He fashions each aright
Its vital part to take.

"Wisdom He makes to guide the sap
Where the high blossoms be,
And lust to kill the weaker branch,
And drink to trim the tree,

"And holiness so that the bole
Be solid to the core,
And plague and fever that the whole
Be changing evermore.

"He strews the microbes in the lungs,
The blood clot in the brain.
With test and test He pricks the best,
Then tests them o'er again."—*Bolton Hall.*

THE SWORD AND BELT OF ORION

The belt is composed of the three second magnitude stars standing obliquely on the left. The three smaller stars below in a nearly vertical line form the sword. The center light of the sword is the nebula.

THE SPIRAL NEBULA OF CANES VENATICI

Contrary to the appearance of this photograph, there is no detectable motion in any nebula. This fact defies the nebular hypothesis.

Terrible as are the teachings of this poem, they are the logical result of the doctrine of evolution, which now claims practically all the thinking world. By that doctrine, we are developing toward perfection. For untold ages, we are told, the cosmos has been moving thus. Not for ages still will it reach the highest place. And so, as we move on, sins and crimes and diseases and death are but parts of this cosmos process, over which we have but little control — hence each one is "a law unto himself." Sin, after all, is not really sin, but part of the creational process. Crime is not really crime, but a relic of our imperfect state. And all this is sheer heathenism — essentially the same that the heathen have taught and believed, but in a form to adapt itself to the times and the present state of general knowledge. But its spirit is, to forget a pure and holy and all-powerful God. And if it fully accomplish its purpose, the world is lost.

True, there is but one power in the universe. But the Bible teaches that all God's creatures have the right and the divine endowment of free moral agency. Truly, in this they are made in the very image of God. But some of God's creatures have taken the illogical, unreasonable, and unnatural position to will against God, to pervert for selfish ends His power and influence intrusted to them — that is to say, to take the materials with which they were to build Paradise, and instead build their Sodoms and their Babylons.

Mysterious as sin may seem to be, it will finally be fully seen to be without excuse. God gave no occasion for it, and in no sense is He its author or originator.

If we read the Bible, inevitably, in following its teachings, we shall learn that God is a personal being. We shall see, it is true, that the whole creation is dependent upon Him, but in no sense is He dependent upon it. To see this, we need read only the following:

"Thou, Lord, in the beginning hast laid the foundation of the earth; and the heavens are the works of Thine hands: they shall perish; but Thou remainest; and they all shall wax old as doth a garment; and as a vesture shalt Thou fold them up, and they shall be changed: but Thou art the same, and Thy years shall not fail." Heb. 1:10-12.

Thus in one scripture are announced most clearly God's eternity, His priority over the creation, and His independence of it; also we discover the transient element there is in it, and that by it He is wholly unaffected. He is revealed as the eternal, unchangeable, omnipotent One.

Nevertheless He is the personal God. No other suggestion comes to us from the Bible. He sits upon the throne of power. This is the Bible conception.

Say some: "This limits God. He is thus restricted to a given area. It does not agree with the idea of His omnipotence and omnipresence."

But the Bible clearly teaches us that God is present everywhere by His Spirit and His power. Thus David presented it. (Ps. 139:1-16.) And when Christ promised His presence with the disciples, it was to be by means of the Holy Spirit. (John 14:16-18.) But though He was thus to be with them to the end of

the world (Matt. 28:20), He was for all of this still seated on the throne of the universe, at the right hand of God (Heb. 8:1; Acts 7:56).

Since God, then, has a definite dwelling place, though present everywhere by His Spirit and power, it is but natural that one should wonder where that place may be.

We would naturally conclude that God's abode is at the center of His universe. He is seated at the place of control. The earth and the other planets of our system revolve around the sun; the sun is at the center, or point of control. The moon revolves around the earth; the earth is at the center of the moon's revolutions, at the point of power and control. The sun, we know, has a path through the heavens; and we naturally believe that for it there is somewhere a center, a point of control. This center for our sun may be some other gigantic sun around which it swings. But whether our sun is the last of the series, or if there is another, then either our sun, or that other sun, central for our sun, must revolve around the great final center where God controls all.

More than one astronomer has risen to the idea that there is a center for the vast universe revealed to us in the study of astronomy. For example, a skillful and careful astronomer named Maedler, when employed at the observatory of Dorpat, in Russia, put forth the idea, in 1846, that there exists some central point in the universe, around which the sun, with its bevy of planets and comets, revolves in the course of millions of years. As a result of his study of this

question, it seemed to him that this center of gravity for the universe, this central sun for the great cosmos, was somewhere in the direction of the Pleiades; and he actually chose Alcyone, one of the Pleiades, as possibly the central sun.

Astronomy is as yet in its infancy. In order that the truth or the falsehood of such a speculation may be verified, the path of the sun and that of each of the stars must be watched for years, until the circles they make are manifest; and then perhaps it will be possible to find the center, the common center, if such there is, of all their orbits. Astronomy has not yet gone far enough to perform such a gigantic task. Ages perhaps would be needed to do this.

But astronomers have demonstrated that the stars are in motion; and if time were given them — ages possibly — they might determine the actual paths or orbits of enough of the stars to be able to discover the center of them all. We cannot expect it in our time, however. "All that can now be said is that the solar system is moving towards a point near to the bright star Alpha Lyræ with a velocity of about twelve miles per second. It will require some years yet to reach final values. So far as we know, the solar motion is uniform and in a straight line."— *Holden's "Astronomy," page 406.*

Its path seems to be a straight line because its orbit is so large, and because all we may observe for years is so very small a part of the whole that we can detect no variation from a straight direction. But all the paths of heavenly bodies so far measured lead us to

the conclusion that the paths of all the suns, or stars, must be circles, ellipses, or other forms of closed orbits, with somewhere a center appropriate for their movements.

Every analogy teaches that creation is centered; and to think that there can be other center than the Creator Himself, is irrational. He is the central source from whom flow all life and power and blessing. Of Him General Mitchel has said: "At His bidding, every planet, and satellite, and comet, and the sun himself, fly onward in their appointed courses. His single arm guides the millions of sweeping suns, and around His throne circles the great constellation of unnumbered universes."

Whether our sun revolves directly around the great center of the universe, or around some other star or stars that in turn circle the center of infinity, we cannot say; but the conclusion is irresistible that there is such a center for the universe, and that there God controls and guides all things.

We may not be able to demonstrate these things now; but in the ages to come, fields of knowledge and power will be opened to the redeemed that will clear up every mystery. "All the treasures of the universe will be open to the study of God's redeemed. Unfettered by mortality, they wing their tireless flight to worlds afar,— worlds that thrilled with sorrow at the spectacle of human woe, and rang with songs of gladness at the tidings of a ransomed soul. With unutterable delight the children of earth enter into the joy and the wisdom of unfallen beings. They share the

treasures of knowledge and understanding gained through ages upon ages in contemplation of God's handiwork. With undimmed vision they gaze upon the glory of creation,— suns and stars and systems, all in their appointed order circling the throne of Deity."—*"Great Controversy," page 677.*

"Suns and stars and systems, all in their appointed order circling the throne of Deity." This is the marvelous conception. It is the grand and final thought in all study of astronomy. More than one astronomer has felt the force of the generalization, and has risen to the conception, and has attempted to verify, by astronomical observation, what he believed to be true.

Gifted with more than mortal sight, from the vantage point of such a center, one might see how—

"Below lay stretched the universe.
There, far as the remotest line
That bounds imagination's flight,
Countless and unending orbs
In mazy motion intermingled,
Yet each fulfilled immutably
Eternal nature's law.
Above, below, around,
The circling systems formed
A wilderness of harmony;
Each with undeviating aim,
In eloquent silence, through the depths of space,
Pursued its wondrous way."—*Shelley.*

From such a viewpoint, we could see stars by the million. "They are strewn through endless space like the blinding snowflakes of a Western blizzard. They are as thick as the leaves of an earthly forest."

As we contemplate it, we say:

"This is a wondrous sight,
And mocks all human grandeur."

We now raise the question, Is there any portion of the heavens discovered by astronomers, that in any sense suggests a fitness to be the dwelling place of Deity? We answer that there is one, and only one, which at all meets the conditions, and this is the constellation Orion.

The astronomer Garrett P. Serviss one evening was watching with a friend the matchless spectacle of Orion advancing to the meridian, when his companion suddenly turned to him and remarked:

"Is there not some vast mystery concealed in that part of the heavens? To me, at least, it seems so; for I can never shake off the impression that the creative power which made the universe lavished its richest gifts upon the locality in and surrounding Orion."

And Serviss argues for the same thing. We quote his words:

"The same thought has doubtless occurred to hundreds of others while gazing upon that star-bedight region. The heavens are not everywhere alike, any more than is the face of the earth. One of the greatest charms that draws the stargazer to his nightly entertainment, is the astonishing diversity of the views in various directions.

"On earth we do not find diamonds or rubies in all countries. They are confined to certain localities, such as the diamond fields of South Africa, and the gravels of Burma. In a similar way there are particular localities in space where not only do specially brilliant stars throng together, but where those stars possess

peculiarities of their own which serve to rank them by themselves.

"The region about Orion is perhaps the most wonderful of these apparently favored places. Spectroscopic analysis, as well as the general appearance of the lucid stars in that part of the sky, warrants their being thus set apart under the specific denomination of the 'Orion stars.'

"It is the part of the visible universe to which one would most willingly pay a visit if human personality could quit this little earth; just as we are drawn to that side of a garden where the magnificence of the flowers shows that the soil is richer and its products more abundant and splendid than elsewhere.

"This begemmed portion of the sky is roughly delimited by seven or eight of the finest stars in the heavens, all of the first magnitude, and marking the corners of an immense hexagon with Orion situated not far from its center.

"It is a spectacle well worth looking at, and one that requires the use of no optical instrument whatever.

"The northernmost point of the great hexagon is indicated by the beautiful milk-white star Capella in the constellation Auriga. At the northwest corner shines the rose-red Aldebaran, in the Hyades, on the forehead of Taurus. The southwest corner is illuminated by Rigel, the gleaming white star in the foot of Orion. Then, over in the southwest blazes and scintillates the imperial Sirius. Above Sirius is Procyon, slightly yellowish white; and above Procyon, at the northeast corner, are the Twins, Castor and Pollux,

which, although individually inferior in brightness to the others, reinforce one another by their appearance of companionship. Not far from the center of the hexagon shines the orange-colored star Betelgeuse, in Orion's shoulder; and below that, in the direction of Rigel, appears the row of three equal stars in Orion's belt, as attractive to the eye as so many brilliant diamonds set at regular distances apart upon the golden bar of a brooch.

"Photography has shown that the middle portion of this region, including the whole constellation of Orion, is enmeshed with mysterious loops and laces of nebulous cloud. For the possessor of a telescope there is here intellectual entertainment for many an evening; while those who look with the naked eye alone find the display magnificent beyond description. There is not one of the great stars that have just been named that is not incomparably mightier than our sun. It is an education to gaze and meditate upon that Golconda of the heavens."

It is not difficult to find statements from astronomers regarding the primacy of Orion as the one grand spectacle of the skies.

"The brilliancy of the stars in Orion, the conspicuous belt, and the telescopic objects which it contains, alike render this group remarkable, and place it perhaps at the head of the constellations." "We have already stated that the great nebula in the constellation of Orion is one of the most interesting objects in the heavens. It is alike remarkable whether we look at its size or its brilliancy, the care with which it has

been studied or the success which has attended the efforts to learn something of its character. . . . Even whole volumes have been written which treat of nothing else."—*Ball's "Story of the Heavens," page 454.*

"The Encyclopædia Britannica" calls it "one of the most remarkable nebulæ." Another writer names it "supreme in the glittering skies of our northern winter," and further remarks, "The telescope does not reveal in all the heavens a more wonderful object than the great nebula lying just below Orion's belt." ("The Stars in Song and Legend," chapter on Orion.) Another says, "One of the most remarkable and brilliant nebulæ." ("The Beauty of the Heavens," page 93.) Another writer declares: "All other irregular nebulæ sink into insignificance compared with that shown by an opera glass as a silvery patch round one of the stars in Orion's sword. This extraordinary object (M 42) has been under effective observation for 250 years, and during the last eighty has been monographed, mapped, measured, figured, and photographed with a diligence worthy of its preëminence." ("The System of the Stars," page 264.) "The New International Encyclopedia" says of Orion, "It is the most brilliant of the constellations;" and "The Encyclopædia Britannica" remarks that "Orion is one of the most conspicuous constellations;" while Ball says of it: "The very splendid nebula in Orion, which is one of the most glorious objects that can be seen in a telescope." "The great nebula in Orion is known to be the most glorious body of its class that the heavens display." ("In the High Heavens," pages 214, 236.)

Flammarion says: "Let us do homage to the magnificent Orion, most splendid of all the constellations. . . . It is indisputably the most striking figure in the sky, and with the Great Bear, the most ancient in history, the first that was noticed: both are referred to in the ancient texts of China, Chaldea, and Egypt. . . . One of the most magnificent in the entire heavens, Orion is not merely the most imposing of the celestial figures, it is also the richest in sidereal wonders."

The foregoing quotations should certainly settle the preëminence of Orion as to splendor and attractiveness. There are some remarkable things yet to be said about it, which we reserve for another chapter.

CHAPTER XXIII

The Open Space in Orion

A WOMAN who was not an astronomer — who, on her own confession, did not remember ever having looked into an astronomy — nevertheless used an expression regarding the nebula in Orion, that requires a great deal of astronomical lore to explain. It happened near the close of the year 1848.

This writer was describing the events that will take place under the seventh vial of God's wrath as predicted in Rev. 16:17-21. At that time, when the voice of God sounds from the throne, there will be a mighty earthquake, and "the sun, moon, and stars will be moved out of their places. They will not pass away, but be shaken by the voice of God. Dark, heavy clouds came up, and clashed against each other. The atmosphere parted and rolled back; then we could look up through the open space in Orion, whence came the voice of God. The holy city will come down through that open space."—*"Early Writings," page 41.*

We quote the above primarily for the expression "the open space in Orion."

Now, let us delve into the science of astronomy with reference to this matter, and see if the term is due to ignorance. Possibly there is more science in the expression than some learned astronomers have guessed. And finally, if this writer is to be taken to task for using such words, then astronomers themselves should clean house; for some of them have been guilty of similar words, or words even more emphatic.

What is "the open space in Orion"? Is it that which was suggested by Huyghens of the seventeenth century? He is supposed to have discovered the nebula in 1656. It struck its distinguished observer with amazement, as something totally different in its nature from those sidereal aggregations of which nebulous objects had hitherto been found to consist. "The aspect of the heavens around this nebulous light was intensely black, a circumstance which suggested to Huyghens the idea of the phenomenon's being occasioned by looking through an aperture in the heavens into a luminous region beyond." ("History of Physical Astronomy," by Robert Grant, page 563.) Or as another astronomer puts it, "Even Huyghens, the discoverer, . . . was already of the opinion that in viewing it we saw, as it were, through an opening into a region of light." ("The Universe of Suns," Richard Proctor, quoting from Herschel.) I believe that Huyghens's own words, describing his sensations, were, "a curtain opening, through which one had a free view into another region, which was more enlightened."

But this is not the idea to be conveyed by the expression, "the open space in Orion." The sky is not

like a solid wall, and the nebula a sort of curtain-like opening into another room, so to speak — a place better lighted.

The ancient heathen writers, ignorant of astronomy and of the nature of space, supposed the sky to be a huge crystal dome. They thought that lightning was a momentary opening through the wall of this dome, disclosing the fiery ether beyond. Huyghens seems to have adapted his idea of the nebula to this notion of the ancients, apparently thinking that the nebulous light was an opening through the darker areas of space into one more enlightened.

There is no doubt that the nebula is an area more enlightened; but we do not see it through an opening, for all space unoccupied by heavenly bodies is open space. No; there is a deeper meaning than any of this in the expression, "the open space in Orion."

To understand the term, let us consider conditions in other parts of the heavens quite similar to those in Orion. From a three-volume book on astronomy, I quote words describing an interesting incident in the lives of two of the greatest of modern astronomers. It throws light upon the question under consideration. To quote:

"Though we talk of the 'starry' heavens, and especially associate the Milky Way with the idea of stars, yet it must be remembered that there exist in the Milky Way certain places which seemingly are absolutely devoid of stars. When Sir John Herschel was preparing for his well-known expedition to the Cape of Good Hope in 1833, his aunt Caroline Herschel

wrote and requested him to pay particular attention to the tail of the Scorpion, because Sir William Herschel had been much struck with the absence of stars there and with the altogether abnormal disposition of the nebulous matter which exists there.

"Sir John, writing to his aunt on June 6, 1834, replied that he had examined parts of the constellation Scorpio as requested, and that he had found many clusters of stars, and a nebula of remarkable shape. His aunt, in thanking him, said: 'It is not to clusters of stars that I was referring. One night your father, after a long and painful silence, cried out, *Hier ist wahrhaftig ein Loch im Himmel* [Here is truly a hole in the heavens]; and after having dwelt a long time on it, he left it, not knowing what to make of it.' On the strength of this statement, Sir John Herschel seems to have returned to the subject, with the result that he found, in the following, patches of sky absolutely devoid of all stars.

R. A.		*Decl.*	
h.	m.	°	′
16	15	—23	56
16	19	26	3
16	23	24	25
16	26	24	14
16	27	—24	0

Ultimately it would seem that he found no fewer than forty-nine such void spaces."—*"The Starry Heavens," Chambers, volume 3, pages 110, 111.*

The cut used by Chambers in connection with the paragraph quoted, aptly shows the remarkable condi-

tion in the nebula which caused "the founder of modern astronomy" to use the expression, "a hole in the heavens."

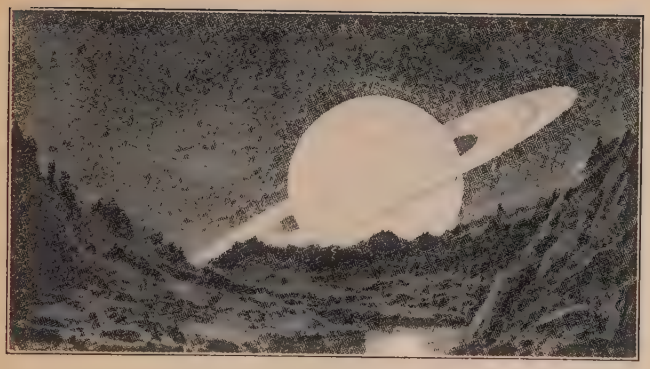
The picture makes it appear almost as if some mighty sun or heavenly globe had torn through the nebula, leaving the opening behind.

Thinking this problem out, Sir John Herschel gave his views of the matter in the following words: "In the Coalsack (near *a* Crucis), a sharply defined oval space free from stars, it would seem much more probable that a conical or tubular hollow traverses the whole of a starry stratum, continuously extended from the eye outwards, than that a distant mass of comparatively moderate thickness should be simply perforated from side to side."—*"Outlines," section 792, page 532.*

Because of this suggestion from Herschel, we find Humboldt writing of the same phenomenon as follows:

"William Herschel's consideration of wholly starless regions in Scorpio and Serpentarius, and which he has termed 'openings in the heavens,' led me to the idea that the starry strata, lying behind one another in such regions, may be less dense, or wholly interrupted, and that our instruments being insufficient to penetrate to these last strata, 'we look into the remote regions of space as through tubes.' "—*"Cosmos," volume 4, pages 348, 349.*

In the first volume of his "Cosmos," Humboldt speaks in a quite similar strain. I quote: "If we picture to ourselves the telescopic stars lying behind one another, these starless regions in Scorpio and Serpentarius may, I think, be regarded as tubes through which



SATURN RISING
As this planet might be seen from its nearest moon.

THE FIRMAMENT OF SATURN ILLUMINATED BY ITS RING

Saturn is about 885,000,000 miles from the sun. Its year is almost thirty of ours, and consists of 25,217 Saturn days. If it has seasons, they each last over seven years. The ring of Saturn has three parts, supposed to consist of relatively small particles rotating about the planet.

Air in Motion Exerts Tremendous Power.

we may look into the remotest depths of space. Other stars may certainly lie in those parts where the strata forming the canopy are interrupted, but these are unattainable by our instruments."—*"Cosmos," volume 1, pages 142, 143.*

And the author of a life of William Herschel has referred to this matter in most striking terms.

"The Maker, Governor, and Upholder of all these worlds and universes is one and the same. Who He is, what is His central seat of power, no telescope, no glass prism, can reveal. Amid the wonders of infinite space and time, our standards of measurement and knowledge may be said to be our five senses; and if one of these, sight, were taken from us, our sphere of knowledge would be immeasurably reduced in extent. On the other hand, an addition to the senses we have, a quickening of the inner light, might reveal this Builder of worlds, His palace, His living armies, with a distinctness, a fullness, hitherto unknown. Herschel evidently thought this when he stood in wondering awe before the hole in the heavens."—*"William Herschel and His Work," by James Sime, M.A., F.R.S.E.*

We see, therefore, that some of the nebulæ have the peculiarity of an open space in them; and Orion is one of these. But the open space in Orion has a significance of its own.

Thus these men of science have used expressions that debar any adverse criticism of Mrs. White's term "the open space in Orion."

As has been explained by these astronomers, we may speak of an opening in the nebula of Orion. It

is situated, however, just where one might least expect to find it; namely, in the middle and brightest part of the nebula. This portion contains apparently six or more stars, four of which are so mutually related as to mark the corners of a rude square or trapezium. Of this interruption in the nebula, Sir John Herschel has said, "It is remarkable, however, that within the area of the trapezium no nebula exists." ("Outlines," page 609, "Observation at the Cape of Good Hope."

Not only is there an opening in the nebula at this place, but the whole nebula itself is conical or concave, with the larger rim directed nearly toward the earthly observer. I quote regarding this:

"The multiple star Orionis forming the trapezium might be called the foundation stone of the edifice. All the lines of its architecture are laid down with reference to it; and intimate physical associations of the stars with the gaseous stuff surrounding them has been spectrographically demonstrated by Sir William and Lady Huggins, and amply ratified by Professors Frost and Adams.

"Surrounding the trapezium in the brightest of the nebula, . . . emanations (or what seem such) from . . . [this] core stretch away in *wide curves* to form outlying portions of the nebula.

"The whole fabric of the nebula is concave towards an axis passing the trapezium in a northeasterly and southwesterly direction."—*'The System of the Stars.'*

The interruption or break in the nebula around the multiple star or the trapezium has been noted by Newcomb. He says:

"The most remarkable feature connected with the nebula of Orion is the so-called trapezium. . . . That these four stars form a system by themselves cannot be doubted. The darkness of the nebula immediately around them suggests that they were formed at the expense of the nebulous mass."—*"The Stars," pages 180, 181.*

We have already quoted the statement of one writer to the effect that apparently emanations stretch away from the trapezium, the core, as it were, of the nebula, in wide curves, to form the outlying portions. Another speaks of this as "the nucleus of a far-spreading spiral formation, probably an outlier of the Milky Way." ("Nelson's Encyclopædia," article "Orion.")

Ball, in his "The Story of the Heavens," admits that "there seems to be an empty space in the nebula surrounding the multiple star." (Page 455.)

Putting all these statements together, if human observation is worth anything at all, the nebula in Orion is like a huge funnel, so to speak, with the larger opening toward us, and the tube-like portion terminating in the region of the trapezium. All this will appear quite clear before we close the chapter.

But let us digress for a moment to discover, if we can, what nebulæ are.

Astronomers now believe that the nebulæ are clouds either of fine particles, or of a gas. The light given out is something entirely outside man's experience. Astronomers are puzzled as to its origin and conditions. Some suppose this light to be cold light, giving out no more heat than does interstellar space, which

is several hundred degrees below zero. Others suggest that the light is due to the heat of fine solid particles, and that therefore there is sensible warmth, or even great heat, in the nebulæ.

"This titanic mass of pearly light — whence its origin? If it is a 'cold light,' a luminosity not due to heat, as in the case of the firefly, then the mystery is beyond any solution in the present power of science. If due to heat, then the quantity of heat must be as great as that of millions of white-hot suns."—*Professor Larkin, of Mount Lowe Observatory.*

Another writer on astronomy has something interesting to say regarding the appearance of the Orion nebula:

"We are looking at some gaseous material of a bluish [some say greenish] hue. The light with which it glows is no reflected sunlight. The nebula is indeed indebted to no foreign source for that weird — I had almost said ghostlike — radiance which it gives forth. The light comes from the nebula itself. But how, it may well be asked, should a purely gaseous substance be able to radiate forth light? It is easy for us to comprehend how stars or suns or comparatively solid bodies can, in virtue of their tremendous temperature, glow with heat like red-hot or white-hot iron. It is true that flame is gas in an incandescent state; but in flame, a vehement chemical union of oxygen with some other substance is in progress, and this is the source of the heat and the light that flame gives forth. We cannot regard the great nebula in Orion as originating in anything resembling flame."—*Sir Robert Ball.*

"The nebula is a luminous body, but ordinary gas is invisible. We do not see the gases which surround us, and which form the atmosphere in which we live. How, then, if the nebula consisted merely of gaseous matter, would we see it shining on the far-distant heavens? A well-known experiment may suffice to remove this difficulty. We take a tube containing a very small quantity of some gas: for example, hydrogen, which is usually invisible: no one could tell that there was any gas in the tube, or still less could its character be known; but pour a stream of electricity through the tube, and instantly the interior begins to glow with a violet light. What has the electricity done in this experiment? Its sole effect has been to heat the gas. It is, indeed, merely a convenient means of heating the gas and making it glow. We do not see the electricity, it is rather the gas heated by the electricity. We infer, then, that if the gas be heated it becomes luminous. It does not burn in the ordinary sense of the word; no chemical change takes place. The tube contains exactly the same amount of hydrogen after the experiment that it did before. It glows with heat just as red-hot iron glows. If, then, we could believe that in the great nebula in Orion there were vast volumes of rarefied gas in the same physical condition as the gas in the tube while the electricity was passing, then we should expect to find that this gas would actually glow.

"To settle the question as to the real nature of the nebulæ, we must call in the aid of that refined method of investigation known as spectrum analysis. . . . The spectrum of a gaseous nebula is a remarkable sight.

Instead of the continuous band of colors, crossed by dark lines, which is characteristic of the spectrum of a star, the visible nebular spectrum consists of seven bright lines. Three of these lines correspond to the spectrum of hydrogen; a fourth was formerly thought to be due to nitrogen. This is now shown to be erroneous, the nature of this line and of the remaining lines being not known."—*"The Story of the Heavens," pages 461, 462.*

If you were privileged nightly to scan the heavens with even a small telescope, you would sooner or later meet one of the remarkable celestial objects which are known as nebulæ. They are faintly cloudy spots, or stains of light, appearing very vivid when outlined against the black background of the night sky. There are very few of these visible to the naked eye, and then only to those who understand what they are observing; they look so much like an ordinary star.

The nebulæ are much in appearance like bright white clouds, but they should not for a moment be confounded with them. Clouds are to be found only in the atmosphere; but nebulæ are immersed in the depths of space. Clouds shine by the light of the sun which they reflect to the eye; but nebulæ shine by their own light. Clouds are ever changing and disappearing; but the nebulæ remain unchanged. Clouds are far smaller than the earth; but the smallest nebulæ known to us are not only larger than the earth, but incomparably larger than the sun itself. Clouds are near, at most but a few miles away; but the nebulæ are many millions of miles away from us.

The systematic study of the nebulæ began with the gigantic labors of William Herschel at Slough. He determined to make a complete survey of the entire heavens, and to note all the objects of interest he could detect. To one not familiar with the use of a telescope, this may not seem to be much of a task; but a few facts will make clear the great labors necessary.

Persons looking through the telescope for the first time, expect to see all the sky as observed by the unaided eye; but while the telescope makes a small area look larger, only a small part of the sky is within the field of the telescope.

For example, even a large telescope can take in only one half the area of the moon at one view. To see all of the moon, it is necessary to move the instrument up and down and to the right and the left a little.

You know that the moon occupies only a small portion of the sky; yet, small as it is, the telescope can take in at one view only about one half of it. Suppose the heavens within our view to be covered over with moons close together. They would make of our northern sky a mosaic containing about one hundred and twenty-five thousand moons. As a good telescope could show but one half of each moon at a view, there would be about two hundred and fifty thousand separate fields of view for the telescope.

Thus you will see that Herschel set out to look at a quarter of a million separate spots in the heavens, to note everything of interest within sight, and to make suitable notations of them, with exact location of each object.

He chose the long, fine winter nights, when the stars were shining brilliantly. Herschel stood at the eye-piece of the telescope while the panorama of the sky moved slowly across the field of his telescope. By this means, he examined a strip of the sky as wide as his instrument with each rotation of the earth. All that was necessary to obtain a new strip for view was to elevate or lower the glass slightly, and the rotation of the earth rolled a new strip across his glass.

"As to the constitution of the nebula in Orion. We see that it consists in part of stars, making up, perhaps, in number for their deficiency in size. These stars are bathed in and surrounded by a stupendous mass of glowing gas, partly consisting of that gas which enters so largely into the composition of our ocean, namely, hydrogen. The wide distribution of this substance, the lightest of all the known elements, is one of the most striking facts in the material constitution of the universe."—*"The Story of the Heavens," pages 461, 462.*

The nebula in Orion is one of the most remarkable in the heavens. Ever since the beginning of astronomical research, it has been viewed with increasing interest. It has elicited the admiration of all who have had the privilege of seeing it, and the awe of all who have ever gained even a slight intimation of its distance and magnitude.

The nebula is the most beautiful in the entire sky. By means of photographs, and the larger lenses of modern telescopes, it is found to extend much farther out into space than was at first supposed. Streamers of light have been observed that before were unseen

and unknown. There is a vast network of glittering light, a robe of majestic glory laden and bedecked with gems of stars.

In all ordinary telescopes, the nebula of Orion looks like a mere flat surface. The writer has seen it many times, and has observed its cloud-like light, its soft and tender glow, and has been astounded at its apparent enormous size, the great expanse of space which it evidently occupies.

Now, the eye cannot store the energy exerted by light. The moment we take our eye off the object, the image disappears. The eye can respond only moment by moment to the energy of light as it is received. This is not the case with the modern exceedingly sensitive photographic plates. They store light energy during all the time that they are exposed. Thus the light piles up in its effect upon the sensitive film. All the light that comes to it from a heavenly body is concentrated upon the plate, and produces a cumulative result after several hours of exposure. By this means, objects are revealed, effects are produced, of which the eye is entirely unconscious.

A few years ago Edgar Lucien Larkin, director of the Mount Lowe Observatory, announced that there was an opening into the nebulous matter of Orion. From an article he then wrote for the *Signs of the Times Magazine,* I quote some most remarkable statements, which give us the last word upon "the open space in Orion":

"The reader is invited to come along with me and help to sink a sounding line into the most appalling and

amazing deeps of interstellar space, and to aid in the exploration of a huge cave, depth, or recess in the nebula in the constellation Orion.

"Recent photographic transparencies made on glass plates at the Mount Wilson Observatory reveal the optical property of perspective. What has all along appeared to be a flat surface of nebulous matter, the beautiful shimmer and sheen in the great nebula in the sword of Orion, is shown, in the central regions of these negatives, to be the mouth of a cavern, a deep opening receding into the mighty distance beyond. These large negatives, taken by means of the great concave mirror, five feet in diameter,—the largest in the world,—actually show depths below the shining surface of the nebula, the effect being that the eye looks into the opening and along the apparent sides to the rear."

"The wintry months are here. Orion rises early in the evening, displaying splendid and regal robes of night, garments of cloth of pearl and glittering diamonds. The nebula can be faintly seen by the unaided eye, and better in an opera glass. Go look in the silent hours, and summon all your mental powers, imagining that the central region of the nebula is really the gigantic opening of a cavern leading into inconceivable depths.

"The outlying portions of the nebula are resolved, in these transparencies, when further magnified, into areas of streamers, wisps, sprays, filaments, and starry lace; and these are well seen in the great telescope up here on Echo Mountain. But all these are less in glory

than the supernal vision of the interior of the cavern — the abyss, the chasm in infinity.

"The nebula of Orion is wider in angular diameter than the moon, whose diameter is thirty-two minutes of arc. Cut off all outlying streamers, and treat mathematically a diameter of thirty-two minutes, and the distance and dimensions of the nebula at once submerge human thought as by a flood from infinitude.

"The opening of this recess is at least fifteen minutes of an arc in diameter; and with this value let the mathematical results obtain.

"If we look at any shining point in this nebula in a powerful telescope, and measure its position with exceeding accuracy by means of a micrometer, to-day, and repeat the process six months later, a most astonishing discovery will be made; namely, the two positions are exactly the same. But the earth, during the six months, has moved to a distance from where it was at first of 186,000,000 miles. See what this means. Take the same telescope to the nebula, turn and look this way; then the diameter of the earth's mighty orbit, a line 186,000,000 miles long, would appear to be so short that it could not be measured with the micrometer, an instrument able to measure the diameter of a fine hair.

"But the opening of the cave is at least fifteen minutes wide. How find its width in miles? This is impossible by measuring any shining portion of the nebula; so we must measure near-by stars, and then assume that the adjacent nebula is at their distance from the earth. Some of these neighboring stars are

binaries, these being cases where two stars — giant suns really — revolve around their common center of gravity. By high and abstruse mathematical processes, fair determinations of their distance from the earth can be made.

"The result of a number of measures of the Orion binaries is that their mean parallax is one two-hundredth of one second of arc. Parallax means, go to a star, look back this way, and measure the angular distance of the earth from our sun. The linear distance is 93,000,000 miles, and the angular measurement from these stars in Orion is one two-hundredth of one second. Then two hundred lines, each 93,000,000 miles long, end to end, would fill out one second of arc, or 18,600,000,000 miles. There are sixty seconds in one minute, or 1,116,000,000,000 miles, which, multiplied by fifteen (the opening in Orion being fifteen minutes of an arc wide), equals 16,740,000,000,000 miles. And this is the enormous width of the colossal opening leading into the cavern.

"Then ninety thousand little rings of the dimensions of the earth's orbit, each with a sun in the center, could enter this abyss side by side and be engulfed. And all these dimensions are less than the reality, without doubt.

"The distance of the rear of the chasm from the opening cannot be measured; but it must be at least three times greater in depth than width, or fifty-one trillion miles. But this is also the distance of the giant sun Sirius from the earth. It and Alpha Centauri following would find ample room within this

cosmic deep. Torn, twisted, and distorted masses of shining gaseous matter, adorned with myriads of glittering points,— starry suns, no doubt,— form the gigantic walls; and the whole forms a scene of indescribable magnificence."

We believe, then, that without question, beyond or through this inapproachable light of Orion lie, somewhere, heaven and the throne of God. Mrs. White, without astronomical knowledge, told something about Orion that no astronomer of that time had yet measured up to. Now, without knowing a thing about her statement, and probably not caring to know, they tell us facts which bear out her statement about an "open space in Orion."

Since what she said about Orion is now proved to be true, it seals her further statement about the voice of God sounding down through that zone of glory from His eternal throne.

Orion is a wonderful spectacle to the eye of man, even at the enormous distance from which he views it; but oh, what must it be to sweep through those avenues of brilliant and radiant glory! There is room there for the city of the coming kingdom to pass through in its journey to this earth, that wonder city which John saw in holy vision, coming down from God out of heaven, prepared as a bride adorned for her husband; a city having the glory of God, her light as the flashing of one immense, magnificent diamond. (Rev. 21:2, 10, 11.)

As to the size of this cavern, or corridor, Mr. Larkin has said:

"These negatives reveal the opening and interior of a cavern so stupendous that our entire solar system, including the orbit of Neptune, would be lost therein. In all ordinary telescopes, the nebula looks like a flat surface. I have watched it since the days of youth, in many telescopes of many powers, but never dreamed that the central region is the mouth of a colossal cave."

"Human speech is impotent. Pen of writer, brush of artist, alike are lifeless and inert in any attempt even to describe this interior. Mammoth Cave glories in Kentucky, illumined by electric lights, are so beautiful that words cannot be used in their description. What, then, should be said of the mighty cavern in the depths of depths of Orion's nebula? Torn, twisted, and riven masses of shining gas, irregular pillars, columns and stalactites in glittering splendor, and stalagmites rising from the mighty floor! The appearance is that of light shining and glowing behind Herculean walls of ivory or pearl, and these studded with millions of diamond points — shining stars."

Professor Larkin estimates that the depth of the chasm cannot be less than fifty trillion miles. This is the distance approximately of the bright star Sirius from this earth. It is a distance that light, though traveling at the velocity of 186,000 miles a second, would take eight years to traverse. The distance may be much more than this. It cannot be less. Truly, then, this is an open space, and one of such size and grandeur as to reveal the majesty of the Creator.

Indeed, therefore, the Orion nebula is an object of interest to us all. How infinitely worthy of our study!

And that interest will be augmented many fold when God's voice sounds down through the opening in that nebula, shaking the earth, and declaring to God's people the day and hour of Jesus' coming. Then will come the wreck of the world. Then will come the deliverance of those whose names are written in heaven. Dan. 12: 1-3.

The constellation of Orion appears about midnight in November in the southeastern heavens. In December and January, it is due south about eleven o'clock. In February, you will find it southwest about ten o'clock. And in March and April, it is in the west, and then sets below the horizon.

On the right of Orion, as you face it, and preceding it, are the Pleiades. On the left, following it across the sky, are the brilliant stars Procyon and Sirius, the latter being the brightest star in the heavens. Orion is a great square, with three bright stars in a row close together near its center. Below these, three smaller stars in a row make a sort of handle for the rake whose teeth are the three brighter stars just mentioned. By including another star to the right, these stars seem to outline a kite instead of a rake.

This kite, or rake, is very readily found, as it is one of the most conspicuous spectacles in this region. The three upper and brighter stars in a direct line, sometimes called the three kings, compose the belt in Orion.

The three lower and dimmer stars are called the sword of Orion. The middle star in this sword is the nebula. Even to the naked eye, it appears blurry, or cloudy.

The nebula of Orion has been described by Professor Larkin as funnel-shaped, with the opening at the smaller end. This opening is marked by a multiple star; and around it the nebula seems to be formed, like the petals of a flower from its center. This remarkable star has been named by astronomers Theta Orionis, which means that star in Orion which in point of brightness comes after the other stars of Orion relatively in the same place occupied by the letter θ (th) in the Greek alphabet. You will see, by this, that it is not the brightest star in Orion. There are seven stars preceding it in point of brightness. The brightest star of Orion, or Alpha Orionis, is the star Betelgeuse, the upper left-hand star of the square. Beta Orionis is in the lower right of the square, and is called Rigel. Gamma Orionis forms the upper right shoulder of the colossus as he faces us, and Kappa Orionis is his left foot.

Theta Orionis is in the open space of Orion. In the photograph, we have indicated by a white line where to find Theta Orionis, with its surrounding open space. Unfortunately, because of the bright light of the nebula, brightest of all at the portion just about the open space, the very sensitive photographic plate becomes fogged of much of the details easily seen by the eye through a good telescope. To help you to gain something of an idea of the structure of the nebula, a reproduction of an astronomer's drawing is given. By paying close attention, you will readily find the interesting open place in the nebula. Fix your eye on the largest, brightest part of the nebula. This bright part

Orion's Nebula as Shown by Telescopic Photography.
The picture indicates the whips and streamers of light emanating from the open space which is, as one astronomer calls it, "the core" of the structure.

Cassell & Co., London.

ANOTHER VIEW OF THE NEBULA IN ORION

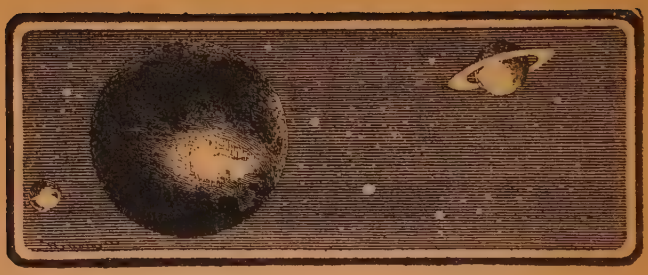
This is an artist's drawing of the nebula, and gives details that are fogged in photography. The small dark spot in the upper portion of the brightest part of the nebula is the rude square or trapezium. This is the open space.

is not much larger than an ordinary grape or raisin seed. At the upper part of this small bright patch as shown in the drawing is a dark portion. It is near the margin of the bright part, but completely surrounded by it. In the dark part, you will notice a few stars. These are the multiple star Theta Orionis.

Of this open space or interruption in the nebula, Sir John Herschel has said, "It is remarkable, however, that within the area of the trapezium, no nebula exists." ("Outlines," page 609.)

That this opening has something to do in relation to the nebula entire is evident from a close scrutiny of its structure. The whole nebula is built about it. I quote from a prominent astronomical writer regarding this:

"The multiple star θ Orionis might be called the foundation stone of the edifice. All the lines of its architecture are laid down with reference to it, and the intimate physical association of the stars with the gaseous stuff surrounding them, has been spectrographically demonstrated by Sir William and Lady Huggins, and amply ratified by Professors Frost and Adams. Surrounding the trapezium is the brightest part of the nebula. . . . Emanations (or what seem such) from . . . [this] core stretch away in wide curves to form the outlying portions of the nebula. The whole fabric of the nebula is concave towards an axis passing through the trapezium in a northeasterly and southwesterly direction."—*"The System of the Stars," pages 264, 265.*



CHAPTER XXIV

Rolled Together as a Scroll

"THE heaven departed as a scroll when it is rolled together; and every mountain and island were moved out of their places. And the kings of the earth, and the great men, and the rich men, and the chief captains, and the mighty men, and every bondman, and every freeman, hid themselves in the dens and in the rocks of the mountains; and said to the mountains and rocks, Fall on us, and hide us from the face of Him that sitteth on the throne, and from the wrath of the Lamb: for the great day of His wrath is come; and who shall be able to stand?"

What does this scripture mean? What is the significance of the heaven's being removed as a scroll that is rolled up? Evidently some great change in the atmosphere is indicated. Another writer describes it in these terms: "The atmosphere parted and rolled back." ("Early Writings," page 41.)

These expressions certainly convey the idea of an opening of the heavens to the eye of man, not now possible.

When we come to consider the effect of the atmosphere in our view of the starry heavens, we learn that it is a matter the astronomers must take careful account of. There is more or less smoke in the atmosphere, or at least floating particles of dust, which obscure the sight to some degree. There are also strata of atmosphere of varying density. And all these things have their part in preventing such a view of the stars as would otherwise be possible.

One who has ever attempted to study the stars with a telescope of larger magnitude, knows something of the difficulty encountered in getting a proper view of the heavens. One may have to wait night after night for a suitable time, only to be disappointed. To the ordinary observatory, there are comparatively only a few nights in the year suitable for the study of astronomy. Oftentimes as one looks through the eyepiece of the telescope, waves of light affected by the currents of air are passing across the object piece of the telescope, causing the stars to dance in a manner that is disconcerting and unsatisfactory. All these things go to show that the atmosphere to a greater or less extent obscures the vision of the heavens which otherwise we might obtain. It is on account of the difficulties of the atmosphere that so many astronomical observatories are located upon high mountains, where the atmosphere is less dense, where it is more uniform, where it is less affected by heat currents and less obscured by the dust and smoke of the cities. In the dry, high air of the mountains, the astronomer carries on his studies with much less to contend with.

A writer on astronomy, himself a trained observer, has made the following statement concerning the work at one of the mountain observatories. He says:

"Who knows the meaning of the word 'clear'? No one is able to understand what 'clear' means if living in a valley. Here on Echo Mountain the atmosphere is so clear that the stars seem near enough to touch, and the mountain air wonderfully pure. The stellar hosts glow with a brilliancy all unknown to those living anywhere near sea level. At all times, save immediately after copious rains, the dust envelope surrounding the earth is visible beneath the summit of the mountain. It covers the entire vista, even out to the sea. To us on the mountain top it seems at times as if every human would choke in this layer of dust.

"Above us at night shine Sirius and Vega like huge diamonds; Arcturus and Spica likewise; and above all, the giant star-sun Canopus, glittering with amazing brilliancy in the distant south, and flashing its rays over myriads of wave crests tossing in the Pacific Ocean. This, the brightest star in the celestial vault, cannot be seen from the latitude of New York. The magnificent constellations of Orion, Hercules, and the Polar Bear are so beautiful that words are powerless to describe them. It is astonishing to behold the apparent nearness of the Galaxy. Mountain perspective, the purity of the air, and freedom from water vapor during two thirds of the year, combine to form an optical illusion. At times, this deceptive influence approaches a night mirage, and one seems to be walking among the very stars.

"Here the 'witching hour' is at sunset, a sunset of orange and flower laden plains, and watery wastes beyond. Round and about the winter solstice, the solar disk may be seen standing on the sea. Soon half of the mighty sphere only is visible. The last view is comparable to an arc light. Then one by one the first magnitude stars are seen, flashing between distant peaks. Before the last gleam of the sun has vanished, Aldebaran, Altair, Rigel, and Procyon illumine the sky. . . .

"Carpet a floor with jet-black velvet, and throw down upon it a myriad of diamonds in wild confusion, and perhaps you may conceive how the densely packed Milky Way appears from the observatory. 'Millions' is a word becoming astronomically obsolete; 'billions of stars' is an expression much more nearly true of the Milky Way. Billions of suns appear in the infinite deeps of the Galaxy. These constitute the apparent cosmic floor, the base of nature, and of the stellar structure. In hundreds of areas, there does not seem to be place for more stars. Millions are finer than the points of needles, and these make a pavement of starry sand.

"I never really saw this sidereal base until with the telescope up here. After several days of rain, the atmosphere is swept clear of dust. Then one is really within cosmic deeps when the telescope suddenly sweeps over fathomless interstellar chasms, doors or windows through which one apparently looks into the very bottom of space. These areas are absolutely black. No sensation within the entire range of stellar

research, at the hour of a mountain midnight, is so completely overpowering as the vision of an abyss in the stellar floor. Round and about these blackened wastes, there are cases where the stars are piled in heaps, raked into windrows, or strewn out into wisps, streamers, filaments, and spray. Yet of all these stellar hosts, the tiniest point may be a white-hot sun, and larger than our little star — the sun. The giant nebula of Orion is a mass of starry lace, a fabric loaded with glittering points."

The statement is made in Scripture, that one day, this veil will be drawn back. We cannot attempt to say just how this obscuring veil is to be removed. Evidently enough, however, it will be by the power of the Creator. The description is that of something which occurs with great suddenness. The heavens will be rolled back "as a scroll," or, as the writer quoted puts it, they will be "parted and rolled back."

Let us use an illustration: Suppose you have a roll of tough paper. This has been rolled until, if stretched out, it will, upon being released quickly, roll back into its old position. Now imagine this sheet of paper held out flat by a hand at each end. Imagine that as the paper is thus held, it is suddenly split through the middle. We know that the two halves will quickly roll apart, leaving an opening between. This is the picture drawn for us by the Word — a picture of what is to take place on the final day.

When God said, "Let there be light," instantly there was light. He spoke, and it was. When the Lord commands nature, it instantly obeys Him. There is

no antagonistic will; there is no opposing power from within. It is absolutely obedient; it responds immediately, obeying implicitly the creative Word. And so, when the voice of God speaks with a power that shakes the heavens and the earth (Heb. 12:26-28), the atmosphere will undergo a change that removes all its veil-like power, its obscuring curtain effect, and we shall seem at once to be brought closer to the shining universe above us.

This must mean a removal, by one act of creation, of everything in the atmosphere that interferes with sight. There are vast quantities of watery vapor in the air at all times. These are apparently invisible, yet they have their part in obscuring the vision. Water may be quickly changed into invisible hydrogen and oxygen by the electrolytic power of electricity. By some unknown yet possibly analogous process, all the water in the atmosphere may be quickly removed by being changed into hydrogen and oxygen; or it might, by some process unknown to us, be condensed into clouds and moved to those portions of the atmosphere not covering the inhabited portions of the globe. But whatever the language under consideration may mean, it certainly indicates a wonderful clearing of the atmosphere.

Just before a theatrical performance is to begin, the curtain rises. Sometimes the curtain does not rise at the appointed hour. The orchestra plays, but the audience are not deceived. They know that the performance will not begin until the curtain rises. When the curtain rises, they know that the performance is

then on. Immediately the actors will appear, and the scenes will be portrayed.

For six thousand years, this world has been a theater to the universe and to man; but the last great act in the drama, at the close of the ages, involves a change of scene. Here on earth, for thousands of years, men have taken their parts honorably or basely, as the case may be. God has kept silence, while men have spoken; God has remained invisible, while the things of time have been ever visible. But now mankind are to be brought in touch with the great invisible forces. They are to view, as never before, the great world hitherto unseen; they are to view with astonishment, through an open curtain, that which for ages has been veiled from their sight.

And so, in the close of time, the great curtain of the skies will roll back. As it does so, instinctively every eye will look upward. Something portentous is about to occur in the heavens. As the atmosphere parts and rolls back, men will be brought, as it were, into the very midst of the stars. Whereas now the light of these celestial bodies shines to the eye of man with broken, uncertain gleam, they will then shine with a strong, bright light, as the eye of an avenger. Every star will seem to come thousands of miles nearer. What now seems far away, and vague and uncertain, will then become thrillingly imminent. Stars now obscured by the atmosphere, and therefore invisible to the eye, will shine out with clear and steady rays, revealing thousands of diamond points of light where now there are none; and so the great universe of the

skies will seem all at once to increase the number of its stars, to multiply them by hundreds and thousands, every one nearer, shining more clearly, shining more steadily, telling its story in a way that cannot be mistaken.

High in the heavens shines the great nebula of Orion. For ages veiled to the eye of man by the atmosphere, it has looked like one large milky star; but then it will be seen to be a halo of light, a shining spot of glory. Instead of being confined to one little spot, it will be seen to extend out, in filaments and wisps and streamers of light, to other stars in the Orion constellation. It will be an awful sight for him who has reviled the idea of a God. For him who has lived for years under the curtain of nature, it will be terrible to find this curtain suddenly withdrawn, and himself brought face to face with the infinite riches and glories of God's mighty universe.

But the curtain of the air will not be withdrawn for man to view merely the stars and the nebulæ. A scene of far more, yea, of transcendent importance is about to appear before his astonished gaze. Far away, yet clear to the eyes of earth's inhabitants, will appear the sign of the Son of man. At first, it will seem no larger than a man's hand. Dark it will appear in contrast with the glory streaming from the heavens; but the form will be unmistakable. Every eye will behold it as the sign, the token, of the Son of man. Christ, the rejected, yet the Judge of all the earth, is coming. He will be emblazoned with all the glory of His Father; He is coming clothed in His own transcendent

beauty; and with Him will be all the shining cohorts from the courts of glory — every angel, so that there will be silence in heaven as this mighty retinue sweeps down from heaven to earth.

It is to enable mortals to behold this picture, that God will withdraw the curtain of the skies. It is that man may view unhindered the coming of the Son of God. For ages, His word has been pledged — "Every eye shall see Him;" and, true to that word, every eye will see Him.

As those who have rejected Him behold the awful sight, they will cry for the rocks and the mountains to fall on them and hide them from the wrath of the Lamb, "for the great day of His wrath is come; and who shall be able to stand?"

Even those who have accepted Him, those who have lived for Him in the earth, and have borne their testimony for the cause of righteousness, will be startled at that awful vision of power and brightness; but floating down to them in advance of this mighty procession from the skies will come the word of Christ, like the notes of rarest music, "My grace is sufficient for thee." Strengthened by that assurance, fortified by that power, they will be able to say: "Therefore will not we fear, though the earth be removed, and though the mountains be carried into the midst of the sea; though the waters thereof roar and be troubled, though the mountains shake with the swelling thereof." With a shout of triumph, they will exclaim: "This is the Lord; we have waited for Him, we will be glad and rejoice in His salvation."